Impacts of Domestic Livestock Grazing on the Archeological Resources of Capitol Reef National Park, Utah

IMPACTS OF DOMESTIC LIVESTOCK GRAZING ON THE ARCHEOLOGICAL RESOURCES OF CAPITOL REEF NATIONAL PARK, UTAH

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ABSTRACT

This report presents the results of an impact study regarding domestic livestock grazing and archeological resources in Capitol Reef National Park in southeastern Utah. This study consisted of two components. First, eight select archeological sites located within the Park were examined in order to assess domestic livestock disturbance. Two unrecorded sites, 42WN1651 (lithic quarry) and 42WN1652 (rockshelter), and six sites- 42GA456, 42GA457, 42GA458, 42GA459, 42GA460, 42GA651 (all rockshelters)- are located in the North and the South District, respectively. Domestic livestock impacts on these archeological resources were evaluated qualitatively. Second, thirteen experimental artifact plots were established in the Park in order to obtain both qualitative and quantitative information regarding livestock impacts. Experimental artifact data have been examined with respect to differential artifact breakage and damage, visibility and displacement. The study results are then discussed with respect to archeological interpretation in the American Southwest and management of archeological resources within Capitol Reef National Park.

ACKNOWLEDGEMENTS

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Dr. Alan Osborn was the Principal Investigator/Project Director. Susan Vetter acted as Field Director. Ralph Hartley served as our contact with the Midwest Archeological Center. The field crews consisted of Steven Baumann, Jesslyn Brown, James Dryer, Patrick Flanigan, William Isenberger, Jennifer McNeil, and Laurie Walsh. Laurie created the artifacts used in the plots. Jesslyn Brown drafted all of the figures in the report. Their fine quality enhances this document. Debbie McBride developed and printed all of the figures.

A final word of thanks must go to Peg and Bud Garver of "La Buena Vida Cantina." Their delicious Mexican food and simple hospitality made our work in Capitol Reef a special pleasure. We only wish that they would cater in Lincoln.

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INTRODUCTION

Background

> While cultural factors are the primary agency producing the remains with which prehistorians are concerned, there are in addition noncultural factors which can substantially alter cultural materials as they become part of the archaeological record. These processes have never been described in a way generally useful in evaluating their influence upon archaeological materials. (Gifford 1978:77)

This study is meant to evaluate the impacts of livestock grazing and associated human activities on the archeological resources in Capitol Reef National Park in southeastern Utah. Our investigations are ultimately in response to Public Law 97-341 which was passed four years ago requiring the National Park Service (NPS) and the Bureau of Land Management (BLM) to contract with the National Academy of Sciences (NAS). This interaction between the NPS, BLM, and NAS was to result in an examination of the following: (1) the impacts of livestock grazing on natural and cultural resources of the Park; (2) the impacts of livestock grazing on visitor use of the Park; (3) alternatives to livestock grazing in the Park; (4) the economic impacts of grazing termination in the Park; and, (5) the contribution of additional information regarding livestock grazing deemed necessary by the Secretary of the Interior (National Research Council 1984:1, 3).

Recent archeological research has focused considerable attention on natural processes that transform prehistoric remains in both qualitative and quantitative ways. Such natural transformation processes include weathering, hydrodynamic sorting, aeolian modification, cryoturbation, solifluction, bioturbation (trampling by wild and domestic animals and humans), gnawing and differential consumption by animals, and so forth (e.g., Behrensmeyer 1976; Brain 1981; Binford 1981; Gifford 1981; Wildesen 1982). A number of studies dealing specifically with trampling and its impacts on archeological remains will be discussed later in this report.

Livestock and wild game trampling of archeological materials has been reported for a number of sites throughout the world. McBurney (1960) describes Lower Paleolithic/Acheulean artifacts and associated conglomerate materials at Sidi Zin (northern Tunisia) which bear considerable mechanical wear. He (1960:103) attributes this post-depositional form of wear to herds of large mammals that used Sidi Zin as a watering hole.

Lynch (1974) discusses the <u>Chuquicamata</u> or Chuqui lithic complex from northern Chile. Lynch (1974:360) states that the Chuqui "artifacts" are primarily steeply retouched unifaces which

are typically found along deeply furrowed trails used by shod pack animals, cattle, and iron-tired wagons.

Perhaps one of the best known instances of livestock trampling and impacts on archeological sites concerns the spectacular early hominid locality Olduvai Gorge in east Africa. Fossilized human teeth and cranial fragments were discovered which were believed to represent a 1.5-1.85 million year old Homo habilis. Prior to their recovery, however, these extremely significant human fossil remains were trampled by Masai cattle (Johanson and Edey 1981).

Gifford (1978) points out that archeologists are now more fully aware that static cultural resources reflect both natural and cultural formation processes. Recent ethnoarcheological and actualistic research has greatly increased archeologists' understanding of dynamic processes that formed the prehistoric record (e.g., Gould 1978; Binford 1978, 1981; Gifford 1978; Gifford-Gonzalez et al. 1985). Archeologists have found it essential to conduct field research designed to observe the dynamic linkages between human behavior, natural processes, and static archeological remains under controlled conditions.

The following report presents the results of fieldwork in Capitol Reef National Park, Utah. This study involved two primary field endeavors: (1) to examine select archeological sites (recorded) within the Park in order to assess impacts from livestock activities; and, (2) to establish and to monitor experimental plots within the Park for assessing current livestock impacts. The results of these investigations involving the site survey and experimental artifact plots are presented herein. The introductory section contains background information concerning the biophysical environment, regional/local archeology, grazing history, and a review of archeological disturbance studies which is meant to provide an appropriate context for the remainder of this study. The following overviews and syntheses are included in order to respond to the needs of park management personnel, as well as other specialists and archeologists. Furthermore, this document is designed to be a self-contained study. This introductory information is then meant to be utilized on several different levels of specificity by the reader given an anticipated range of individual interests and concerns.

Environmental Overview

> It is a maze of cliffs and terraces lined off with stratification, of crumbling buttes, red and white domes, rock platforms gashed with profound canons, burning plains barren of even sage - all glowing with bright color and flooded with blazing sunlight. Everything visible tells of ruin and decay. It is the extreme of desolation, the blankest solitude, a superlative desert (Dutton 1880:286-287).

The Waterpocket Fold dominates Capitol Reef National Park (Fig. 1). This fold is one of the large monoclines of the Colorado Plateau. It extends from the Colorado River south of the Henry Mountains northwestward along the east side of the Circle Cliffs and to the north end of Thousand Lake Mountain. The fold results in a nearly vertical exposure of sedimentary strata stretching over 160 kilometers from north to south (Smith et al. 1963:57). Only a few water courses breach the barrier or "reef" created by the fold. The Fremont River crosses the Waterpocket Fold below Fruita in a precipitous gorge. Grand Wash, Capitol Wash, Pleasant Creek, Sheets Gulch, and Oak Creek also cross Waterpocket Fold in precipitous gorges. Before the completion of Utah State Highway 24 through the Fremont River Canyon in 1962, access to Fruita and the Capitol Reef area from Hanksville was via a road in the gorge along Capitol Wash. At its narrowest point, this gorge is 7.5 meters wide. Sandstone cliffs tower over 100 meters above the gorge. Flash floods frequently made the road impassable.

The approximately 98,000 hectares of Capitol Reef National Park include most of the Waterpocket Fold and some adjacent plateau, valley, and badland topography. Elevations in the Park range from under 1200 meters on the south to over 2500 meters on the northern boundaries, where the Park adjoins Fish Lake National Forest on Thousand Lake Mountain. In the North District of the Park, north of the historic Fruita area, pediment gravels cap many flat-topped hills and benches. The pediment gravels are believed to be of pre-Wisconsin age. Partly rounded lava boulders and many smaller fragments with a small proportion of granules and sand compose the pediment gravels. Parallel to the northeast exposure of the Waterpocket Fold runs a three part drainage system of deep troughs and hogback ridges. The South Desert, Hartnet Desert, and Middle Desert form the three long troughs of the drainage. The Middle Desert lies the farthest east. The upper portion of the Middle Desert is known as Cathedral Valley. The "cathedrals" are erosional remnants of Entrada sandstone capped by Curtis formation that can reach over 150 meters in height (Fig. 2). Igneous sills and dikes are also common in this area (Smith et al. 1963). In the South District of the Park, the steeply dipping beds of sedimentary strata in the Waterpocket Fold tighten to a banded ribbon that snakes southward toward Lake Powell.

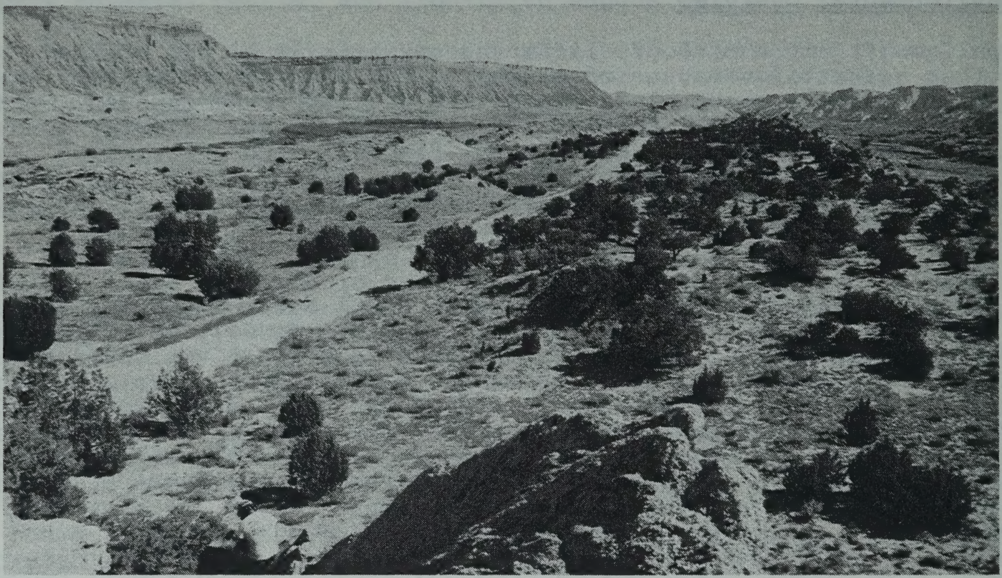

Figure 1. Waterpocket Fold.

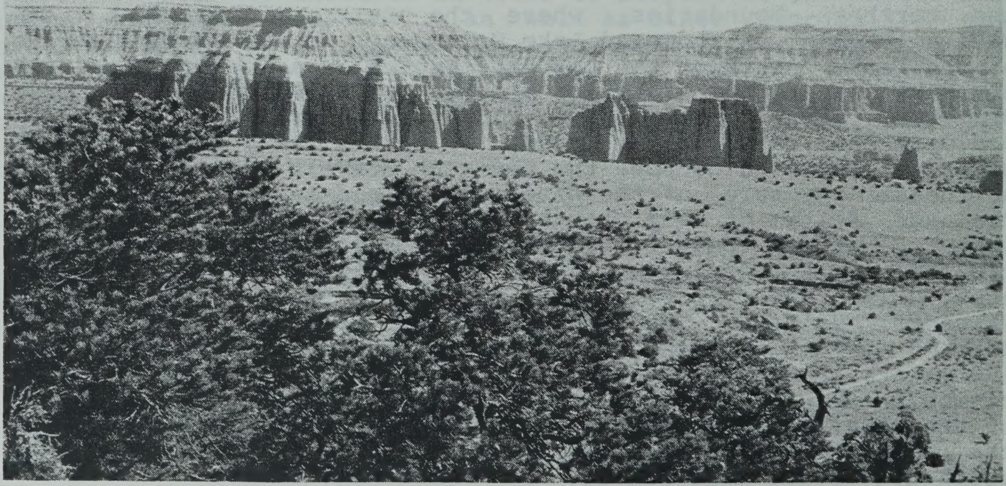

Figure 2. Cathedral Valley.

Climate tends to vary directly with the altitude gradient. The prevailing climates are continental and semi-arid (National Research Council 1984:4). The annual precipitation ranges from about 13 centimeters at the lower altitudes to about 51 centimeters on higher ground. The 1947-1973 mean annual precipitation at Fruita was 17.09 centimeters (United States Department of the Interior 1974). Surface water is very scarce in the Park. The Fremont River flows through the Fruita area. The only other perennial streams in the Park are Pleasant, Sulphur, and Oak Creek and the lower reaches of Halls Creek at the extreme southern tip of the Park. Springs and seeps may also be found in the Park. The only other sources of water are the man-made stock ponds and the natural "tanks" found in the Waterpocket Fold.

Desert shrub vegetation dominates the lower elevations of the Park. The canyons and washes here exhibit a more southern flora, representing the northern extension of the Lower Sonoran (Dixon 1935:279). Pinyon-juniper woodland covers the higher elevations. Large areas of the Park are naturally barren as a result of rock outcrops and badlands on shale soils. The vegetation in the Park grows under an arid environment that results in widely spaced plants and a relatively low total plant cover. In the pinyon-juniper woodland of the higher elevations, hazelrush, galleta grass, western wheatgrass, and blue and black grama compose the common understory plants. Alkali sacaton, galleta grass, Indian rice grass, squirreltail, and needlegrasses, along with fourwinged saltbush, winterfat, and areas of greasewood and shadscale are the major species of desert shrub vegetation (National Research Council 1984:5). Fremont cottonwood, tamarisk, and streambank willow occupy the streamsides. Over 600 species of plants occur within or near the Park, including approximately 128 exotic species (United States Department of the Interior 1982:59).

Capitol Reef National Park contains approximately 260 species of mammals, birds, reptiles, amphibians, and fishes. The most abundant are birds, small mammals, and reptiles. The mule deer is the most common large mammal. Common birds in the Park include the red-tailed hawk, sparrow hawk, mourning dove, golden eagle, white-throated swift, and various swallows. The peregrine falcon has also been sighted in the Park. The ring-tailed cat, badger, fox, coyote, bobcat, and mountain lion are the dominant carnivores (United States Department of the Interior 1982:59).

The Waterpocket Fold determines much of the natural environment of Capitol Reef National Park. The crest of the fold rises about 700 meters above the surrounding area. Stream-carved gorges cut canyons through the fold with walls over 100 meters high and sometimes less than ten meters across. Igneous dikes and sills, gypsum plugs, mudslides, and sinkholes contribute to the diverse geologic character of the Park. These diverse geologic features create an extremely unusual array of habitats with narrow niches and microclimates. This variety in habitats results in the diversity of plants and animals in the Park.

Archeological Overview

History of Investigations

Remains of prehistoric activities in the Park have been known since Mormon pioneers settled in Fruita in the 1880s. One of these early settlers reportedly collected "a wagon load" of artifactual material from the surrounding area. These items were traded to a commercial artifact dealer Jim Knelly in 1888 for a horse and saddle. This material apparently included ceramic pots, baskets, knives, moccasins, and mummified human remains. During the winter of 1892-1893, Don McGuire of Ogden and Dr. Talmage of Salt Lake City were commissioned by the state and the Mormon Church museum, respectively, to collect archeological material for exhibit at the Chicago World's Fair. They obtained artifacts from excavations on the south side of the Fremont River at an unnamed site east of the former Tine Oyler ranch. After the Chicago exposition, most of the artifacts were placed in the Mormon Church museum. Maguire reported that some of the collection was traded to other institutions (Kelly 1945).

Four or five room blocks were excavated on a river terrace near Fruita by a team of "three French archaeologists, whose names appear to be cut on the cliff nearby" (Kelly 1945a:3). No information is currently known about these individuals or the results of their activities. During the late 1890s, Ephraim P. Pectol and Charley Lee of Torrey, Utah, collected large amounts of artifactual material from rockshelters on upper Sulphur Creek north of Torrey. Much of this material was also donated to the Mormon Church museum.

It was not until the late 1920s that archeological investigations along the Fremont River drainage were documented in a manner that permits the association with recorded sites today. In the spring of 1928, Donald Scott, Assistant Director of the Peabody Museum of Harvard University, and his wife compiled notes on prehistoric remains during an exploration of western tributaries of the Colorado River from the Escalante River to the Fremont River and then along that river valley to near the town of Torrey. These notes were subsequently made available to Noel Morss. Morss initiated four summers of archeological investigations in July 1928 west of the Colorado River in southern Utah under the auspices of the Peabody Museum. This work was sponsored by Mr. and Mrs. William H. Claflin and Mr. and Mrs. Raymond Emerson. These investigations later became known as the "Claflin-Emerson Expedition" which was documented by Morss (1931) and Gunnerson (1969). During the 1928 season, Morss investigated at least one site (#94) within the Park and numerous others west of Fruita, north of Torrey, and west of the Park along Pleasant Creek and Oak Creek. He also briefly notes many "Moki Houses" in the Torrey-Fruita area as well as a group of "miscellaneous sites" around Fruita including slab lined cists, basalt "rock-circles," and petroglyphs on basalt boulders. Unfortunately,

these notes are not sufficiently detailed to associate with currently recorded sites. In 1929, Morss recorded another site (#35) within the Park along the Fremont River and two sites (#36 and #37) along the upper reaches of Deep Creek, one site (#27) along Oak Creek and three sites (#24, 25, 26) along or near the branch of Coleman Creek.

James Gunnerson conducted archeological reconnaissance and test excavations for the University of Utah's statewide survey program within the northwest corner of the Colorado Plateau in the mid-1950s. Gunnerson recorded and investigated sites within the Park and in the vicinity of Sandy Ranch, Oak Creek, Pleasant Creek, and along the Fremont River between Fruita and Fremont (Gunnerson 1957:90-101).

Lister's survey in 1958 within the Waterpocket Fold area was conducted as part of the University of Utah's contract with the National Park Service to survey the right bank of the Glen Canyon reservoir project. Lister's investigations in the Waterpocket Fold area were conducted before this area was incorporated into the Park. Lister documented a total of 53 sites. Twenty-seven of these sites are currently within the Park boundaries (Lister 1959; Suhm 1959:184).

During the summer of 1963, Mary Mulroy and Makoto Kowta surveyed portions of the Park under the auspices of the Department of Anthropology at the University of California at Los Angeles and the University of Utah. This survey was concentrated along the Fremont River and Sulphur Creek as well as along Pleasant Creek and around Whiskey Spring. Forty-six previously unrecorded sites were documented and another eight known sites were relocated and documented in their report. Three of the fifty-four sites located are currently outside the Park boundaries (Kowta 1964; Mulroy and Kowta 1964).

Since the early 1970s, archeological work has been conducted primarily in response to proposed ground disturbing activities associated with Park developments. In 1973, Kay surveyed the Notom road from Bullfrog Basin in Glen Canyon National Recreation Area to its intersection with Utah Highway 24. A major portion of this road lies within the Park paralleling Waterpocket Fold. Kay recorded fourteen sites currently within the park, three of which were previously recorded by Lister in 1959 (Kay 1973). During the following year, Calabrese and Anderson examined an area within Fruita to be impacted by an irrigation pipeline although no cultural remains were recorded (Calabrese 1974).

Noxon and Marcus (1978) documented seventy-eight sites with petroglyphs and pictographs in Capitol Reef National Park through a National Endowment for the Humanities grant. Most of these sites had been formally recorded. However, they documented and assigned Utah trinomial numbers to twenty-four Wayne County and two Garfield County previously unrecorded sites. Unfortunately, these sites were never formally recorded with the State of Utah and were not plotted on the archeological base map for the Park.

With the exception of notes and drawings concerning petroglyphs and pictographs very little is known about the character of these twenty-six sites.

In 1979, Hartley conducted an inventory survey in the Fruita Valley in response to proposed sewage disposal and water storage developments. One petroglyph site was recorded (Hartley 1980a). Hartley examined sewer line trenching in the Fruita area during 1980; however, no cultural material was observed (Hartley 1980b). Two additional sites were recorded in 1980 just outside the Park boundary during a seismic line survey in the Middle Desert area (Jacklin 1980). During 1981, Anderson conducted a reconnaissance of proposed wayside exhibit areas near the Sulphur Creek bridge and Pleasant Creek landfill. No cultural resources were observed in the areas of proposed ground disturbance. One site was noted in the Grand Wash area but this site was not formally recorded (Anderson 1981a; 1981b).

In 1984, Kevin O'Connell examined two proposed campground locations and eight trail segments in the Park. He recorded one lithic scatter and one storage structure during these investigations (O'Connell 1984). In June 1986, an archeological crew from the University of Nebraska-Lincoln conducted extensive mapping, surface collecting, and subsurface testing at a portion of an extensive site (42WN1651) encompassing the North District campground (Calabrese 1986).

In January 1986, Marian Revitte, BLM archeologist for the Richfield District, recorded two lithic scatters in association with possible hearths on the eastern border of the Park on a bench between Oak Creek and North Coleman Canyon. This work was conducted at the request of the Park prior to fence construction. In early May 1986, Craig Harmon, BLM Richfield District archeologist, conducted archeological reconnaissance around Bull Spring, Blue Notch Reservoir, and the South Desert Reservoir at the request of Park personnel. No cultural material was observed during this work.

Synthesis

During the last three decades, well documented archeological investigations in the vicinity of the Park have permitted archeologists to develop a broad perspective about the history of human activities in this area. This section will briefly review the results of some of these investigations and summarize the chronological context of existing knowledge claims about human prehistory and protohistory in the vicinity of the Park. No attempt is made to review all of the myriad cultural resource studies conducted in advance of recent developments and current land use practices; however, a number of these investigations have led to more intensive archeological investigations that have been deemed important to the understanding of the long-term human utilization of the area.

Results of archeological surveys adjacent to and in the vicinity of the Park emphasize that surface scatters of lithic material and ceramic fragments are the predominant evidence of prehistoric human activities in this area (e.g. Berge 1974; Hauck 1979a; 1979b; Tipps 1984; Nielson and Hall 1985). These material remains, therefore, constitute the largest body of information that can be potentially transferred into data offering modern man a perspective on prehistoric activities.

Prehistoric occupation of the area surrounding the Park can be summarized within a broad chronological framework that permits discussion of important archeological sites as well as miscellaneous archeological work conducted near the Park. The following discussion will be divided into the commonly recognized periods and/or cultural affiliations: Paleo-Indian, Archaic, Fremont/Anasazi, and Numic-speaking groups.

The Paleo-Indian cultural tradition is generally recognized from 12,000 B.P. to about 7000 B.P. and is most often divided into three subphases. Evidence of this tradition in central Utah is scant and no stratified sites with undisputed evidence of Paleo-Indian occupation have been documented around or near the Park. Nevertheless, artifactual evidence from the general area does suggest that Paleo-Indian activity did occur within the surrounding region.

The Llano subphase (ca. 12,000 B.P. - 10,000 B.P.) is characterized by the hunting of Pleistocene fauna and use of the Clovis point, a large, lanceolate, fluted dart point. Clovis points have been found in association with mammoth in eastern Colorado, Wyoming, New Mexico, and Arizona. Isolated Clovis points have, however, been found throughout the Intermountain West and southwestern United States. Although no Clovis points are known to have been discovered within the Park, Gunnerson (1956) conducted test excavations at the Silverhorn site (42EM8) located north of the Park where a Clovis point had previously been found on the ground surface. No Clovis material was discovered during the test excavations, however. Another Clovis

point was found at a lithic scatter near a spring in Wayne County (42WN642). A site (Lime Ridge site - 42SA16857) located southwest of Bluff has recently been investigated and attributed to Paleo-Indian occupation. Two Clovis projectile point fragments and numerous other tools were found at the site (Davis and Brown 1986). Other isolated Clovis points have been found in San Juan (Lindsay 1976), Sevier (Tripp 1966), Juab and Beaver Counties.

The Folsom subphase (ca. 11,000 - 9000 B.P.), somewhat overlapping the Llano, is characterized by a projectile point that is lanceolate, bifacially fluted with basal ears, a concave base, and is generally smaller and thinner than the Clovis point. The Folsom points are also found at kill sites in association with the extinct Bison antiquus. Most Folsom points have been found in the High Plains area, however, the Montgomery Folsom site (42GR1956) located a few miles south of Green River has been attributed to Paleo-Indian occupation. Two Folsom projectile point fragments and numerous other stone tools found at the site are similar to Folsom Paleo-Indian artifact assemblages documented from the High Plains area (Davis 1985). Folsom points have also been found near Squaw Springs in Wayne County and in the San Rafael area south of Green River (Tripp 1967). A number of other Folsom points have been found in San Juan, Duchesne, Garfield and Millard counties (Hunt 1953, 1960; Hauck 1979a:64-65).

The Plano subphase extended from about 9000 B.P. to about 7000 B.P. and again is characterized by a subsistence pattern that depended on the hunting of large game, particularly bison. More diversity in projectile point types characterize the Plano subphase; however, they typically are lanceolate, precisely flaked and not fluted. Little evidence is currently known of Plano artifacts in southern Utah although there have been reports of so-called Eden points found in the desert area north of the Henry Mountains (Schroedl 1977) and an Angostura-like point was collected in the La Sal Mountains (Hunt 1953). Nevertheless, what is currently recognized as Plano activities is predominantly known from the High Plains area.

The Archaic period (ca. 8000-1500 B.P.) is generally characterized by a hunting and gathering mode of subsistence dependent on a wide range of small game and non-domesticated plant foods. It is thought that during this period hunter-gatherers followed an annual round in response to changing resource availability, living in small, kin-related groups throughout most of the year. The Archaic phase on the Colorado Plateau has been divided into four phases by Schroedl (1976). These continuous temporal divisions (8300-1500 B.P.) are based for the most part, on changes in projectile point styles and inferred population densities. The concept of continuous aboriginal occupation and activities throughout this period has recently been challenged by Berry and Berry (1986). They note, for example, that there is currently no evidence of prehistoric activity on the southern Colorado Plateau between 5000 and 6000 B.P. and very little evidence between about 2000 and 3000 B.P.

These authors argue that it was only during specific periods of increased effective moisture and proportionately greater biotic productivity that Archaic hunter-gatherers exploited this environment. They suggest that significant occupation of the Colorado Plateau began around 8500 B.P. and ceases around 6000 B.P. Evidence of cultural activity is again present at around 5000 B.P. with the onset of greater effective moisture. Small projectile points associated with the use of bow and arrow appear in the archeological record after 2500 B.P. while all archaic dart points except the Elko Series disappear. Between 3000 and about 1500 B.P. there is evidence for a fairly drastic reduction in effective moisture on the Colorado Plateau. These authors argue that it was during this period (ca. 2500-2800 B.P.) that maize agriculture was introduced in the Southwest and subsequently spread throughout the region. The inception of maize agriculture and the Basketmaker II complex may represent an influx of people from some area outside the Colorado Plateau and Basin and Range province of the greater Southwest.

Recent survey in the San Rafael Swell area between the San Rafael River and Muddy Creek north of the Park resulted in eighteen sites being attributed to Archaic period occupation (Tipps 1984:54-55). A small rockshelter (Pint Size Shelter - 42EM625) west of the San Rafael Swell near Quitchupah and Ivie Creeks was excavated in the fall of 1975. Radiocarbon dates from the site established Archaic occupation at 4520±210 and 3390±170 B.P. (Lindsay and Lund 1976). Another rockshelter (Clyde's Cavern - 42EM177) near the western edge of the San Rafael Swell contained corn cobs dating to approximately 1490± 100 B.P., suggesting Late Archaic corn cultivation. Radiocarbon dating of a charcoal sample in Level 1 containing a few Late Archaic artifacts yielded a date of 3070±130 B.P. (Winter and Wylie 1974). A late Archaic burial (42SV2111) excavated near Elsinore, Utah, in 1985 contained about two hundred corn cobs associated with the skeletal remains of an elderly female. Charcoal and corn from the burial pit dated to about 2091±49 B.P. or about 175 B.C. offering evidence of early horticulture in central Utah (Wilde, Newman, and Godfrey 1986).

The most well known excavated site dating to the Archaic period near the Park is Sudden Shelter (42SV6) located in the Fishlake National Forest on the north bank of Ivie Creek. The series of radiocarbon dates from various stratigraphic levels at the site range from about 8000 to 3000 B.P. Two strata containing the highest density of artifactual material dated between 6700 and 6400 B.P. (Jennings, Schroedl, and Holmer 1980). These authors suggest, based on their analysis of the diversity of artifacts, plant remains and osteological material, that the site functioned as a seasonal habitation site occupied mostly during the summer with occasional occupation during the spring and fall.

Another site (Cedar Siding Shelter - 42EM1533) north of the Park on the Price River consists of five rockshelters. Five radiocarbon dates from the site suggest occupation during the Middle Archaic (ca. 5500-3500 B.P.). Another five radiocarbon

dates suggest later occupation during the Late Archaic (ca. 3500-2500 B.P.) after an absence of dated occupation lasting about 750 years. Of additional significance is a third group of radiocarbon dates falling within a range of 2190 to 1980 B.P., suggesting a continuity of occupation in the area between Late Archaic and Fremont times. Another three dates from the site (1220-910 B.P.) and associated artifactual material are attributed to Fremont occupation (Martin, et al. 1983).

Archeological survey in various areas of Fishlake National Forest adjacent to the northwest portion of the Park was conducted in 1979. In the Solomon Basin area near the Park low density lithics (about one per 400 square meter) were observed throughout this pinyon-juniper forest. One high density area (42SV1359) was attributed to middle Archaic occupation based on Sudden side-notched and Hawken side-notched projectile points found at the site. About 5 km west of the Park boundary on Thousand Lake mountain an isolated lithic scatter (42WN1277) was recorded from which one Bull Creek point was identified (Simms 1979). Archeological survey along Utah Forest Highway 10 in Fishlake National Forest about seven miles northwest of the Park resulted in the recording of thirty-six sites, seven of which were attributed to Archaic occupation. Nine of the sites contained artifacts attributed to Fremont occupation and three had Numic occupation characteristics (Nielson and Hall 1985).

Opinions concerning the existence, origin, and constitution, of what has been termed the "Fremont culture" have been diverse. Noel Morss (1931) named the "Fremont" during investigations along the Fremont River drainage in the Park and vicinity. The "Fremont culture" has been subdivided into regional groupings most recently by Marwitt (1970) and Madsen and Lindsay (1977) on the basis of variable "culture traits" (cf. Madsen 1979). In general, however, the Fremont are considered to be characterized by maize horticulture with limited use of beans and squash supplemented by hunting and gathering, pit house and above ground adobe, stone and jacal architecture, a distinctive grayware and painted pottery, a clay anthropomorphic figurine "cult", leather moccasins, half-rod-and-bundle basketry, and a distinctive rock art style emphasizing shield and/or anthropomorphic figures (Gunnerson 1969:133-163; Aikens 1970:202-203; Jennings 1978:184-206).

In a review of the literature and controversy surrounding the Fremont culture, Anderson (1983) has taken the position that Fremont cultural development took place in both the eastern Great Basin and Colorado Plateau ca. A.D. 600 to 1200. In the latter portion of this period (ca. A.D. 950-1200) contacts from the Anasazi in the San Rafael and Parowan subregions are suggested by archeological remains.

Material remains attributed to Fremont were excavated in 1955 at the Poplar Knob site (42SV21) southwest of Emery and north of the Park. Another nearby site, the Old Woman site (42SV7), was also excavated exposing coursed adobe surface structures and

jacal buildings that were contemporaneous with pit houses. The site also yielded a number of anthropomorphic figurines characteristic of "Fremont" sites in the area. Taylor's (1957) assessment of ceramics from these two sites led him to suggest contemporaneous occupation between A.D. 1075 and 1175. Radiocarbon dating later resulted in dates of A.D. 898±200 for the Old Woman site and A.D. 788±250 at the Poplar Knob site (Flint and Deevey 1959:153). Thirty structures were excavated at Snake River Village (42SV5), a "classic Fremont site" of the "San Rafael variant" located upstream from the mouth of Ivie Creek Canyon (Aikens 1967:1). Although Sevier-Fremont pottery predominates at the site, Ivie Creek Black-on-white and Kayenta painted wares are also present.

The Round Springs site (42SV23) on Last Chance Creek north of the Park was excavated in the mid-1950s by Gunnerson (1957:102-105). Although the site had been badly damaged by previous road construction a pithouse was discovered with Fremont plain gray ceramics. During the summer of 1974 three small open Fremont sites were excavated in Ivie Creek Canyon southeast of Emery. At one of these sites, the Fallen Woman site (42SV455), two semisubterranean dwelling structures were excavated (Wilson and Smith 1976). Excavation of Pint Size Shelter (42EM625) near the junction of Quitchupah and Ivie Creeks resulted in radiocarbon dates of 1790±100 B.P. from charcoal obtained from a fire hearth. The radiocarbon sample is considered to date the Emery Gray pottery from Stratum 4 at the site and the onset of Fremont occupation (Lindsay and Lund 1976). Excavations in 1974 at Innocents Ridge, also in the Ivie Creek Canyon area, consisted of one semisubterranean pit structure, three surface masonry and adobe dwelling structures, and one surface adobe and masonry storage structure. On the basis of assumed intrusive Anasazi pottery types, the site was dated to between 1125 and 1225 A.D. (Schroedl and Hogan 1975).

A series of eight sites was excavated in 1976-77 south of Hanksville, Utah, along the Bull Creek drainage east of the Park. These sites were attributed to the San Rafael Fremont with "high proportions of Anasazi trade(?) wares." Four radiocarbon dates from these sites range from 800-500 B.P. (A.D. 1150-1450) (Jennings and Sammons-Lohse 1981:15-17). These dates offer some evidence that Fremont occupation continued, at least in this area, beyond that of other horticultural Fremont sites (Lindsay 1986:247). Most recently a series of eleven sites exhibiting Fremont attributes was excavated in the Clear Creek drainage west of Sevier, Utah, in Fishlake National Forest. One of these sites (Five Finger Ridge - 42SV1686) consisted of a large concentration of mid -to- late Fremont period architectural features. Six rockshelters and two storage structures were also excavated. The series of radiocarbon dates taken from these sites suggests that the area was utilized for approximately the last 4000 years (Janetski, Nielson, and Wilde 1985). Other Fremont sites in the Sevier drainage dating from around A.D. 800 to 100 include Backhoe Village (42SV662) near Richfield (Madsen and Lindsay 1977), Pharo Village (42MD180) (Marwitt 1968), and Nawthis

Village (42SV633) in Gooseberry Valley (Jones and O'Connell 1981; Jones and Metcalfe 1981).

The Fremont complex of cultural traits disappears from the archeological record after about A.D. 1200 to 1350. A number of causative factors have been postulated for this phenomenon; e.g. climatic change, expansion of Numic speakers, and population pressure (Ambler 1966; Madsen 1975; Lindsay 1986). Anderson (1983) accepts the suggestion that the Shoshonean expansion disrupted the Fremont subsistence pattern, possibly in conjunction with climatic changes, prompting these peoples to subsist by hunting and gathering. Lindsay (1986) has suggested early Fremont abandonment of the Uinta Basin, southwestern Utah and southern Nevada. As climatic change affected these areas, Fremont peoples moved to larger settlements in the immdediate area of Great Salt Lake, the Utah Valley and the southeastern Utah portion of the Colorado Plateau. Radiocarbon dating of excavated sites in these areas supports not only the idea that such movements occurred but that these areas were also later abandoned. Lindsay's perspective regarding the Fremont complex allows one to conceptualize it in terms of environmental and demographic variability through space and time. Subsistence activities in this area can be viewed as adaptive processes and/or sets of predictable relationships between very basic environmental differences which characterize the alleged subregional groupings of the Fremont. The "Fremont culture" will most likely continue to be difficult to define and integrate within a cultural-historical framework in the greater Southwest.

The lower one third of the Park lies adjacent to an area believed to have been utilized in part by the Kayenta Anasazi. Distinctive ceramics are the material traits recognized as most diagnostic of the Kayenta. The "Kayenta influence" is evident in southern Utah from the Glen Canyon area north to the Coombs Village site at Boulder, Utah (Lister and Lister 1961), past the Henry Mountains to Snake Rock Village (42SV5) on the east side of the Wasatch Plateau. Material remains assigned to the Kayenta are also known northwest of Glen Canyon in the Kaiparowits Plateau. Coombs Village, located just a few miles west of the Park, consisted of seventy-seven jacal or masonry rooms and pit houses, many of which had been destroyed by fire. Charcoal from three pit house beams radiocarbon dated from A.D. 1050±50 to A.D. 1160±80 (Jennings 1978:125). Hauck (1979b) considers Fremont and Kayenta peoples to be contemporaneous in much of the area and to have shared a common developmental type of adaptation to their environment. Lister's (1959) survey of the Waterpocket Fold area yields pottery assigned to both the Fremont and to the Kayenta, especially sherds of the Tsegi Series, known from northeastern Arizona. He notes that the frequency of Kayenta ceramics decreases substantially in the northern portion of the surveyed area and that this spatial distribution of ceramics suggests contact between "peoples of the Fremont culture and Anasazi people from the Kayenta region south of the Colorado River". Over three hundred sites have been recorded on the Kaiparowits Plateau south and west of the southern portion of the Park. Most of the

sites recorded in 1958 and tested in 1961 are attributed to late Pueblo II-early Pueblo III Kayenta occupation based on ceramic types from the sites (Gunnerson 1959; Fowler and Aikens 1963).

Recent archeological survey in the Circle Cliffs Valley area just west of the Waterpocket Fold monocline resulted in the location of sites attributed to the Middle and Late Archaic, protohistoric and historic period (Tipps 1984). Three buried pithouses were located in this area, one of which radiocarbon dated to approximately A.D. 250 possibly representing Basketmaker II occupation; however, Tipps (1984:19) cautions that these pithouses, although located "in the general Anasazi area", could be the result of Archaic or even Fremont occupation.

Numic-speaking Ute and Paiute groups are believed to have utilized the area encompassing the Park from at least A.D. 1250 until historic times. Ethnohistoric and ethnographic sources offer substantial evidence of Ute and southern Paiute activities in the area during the nineteenth century (Kelly 1934; 1964; Stewart 1966; Euler 1966). Their subsistence pattern until well after contact likely consisted of small familial bands foraging for non-domesticated plants and animals. Historic documents often mention horticultural activities of the Paiutes in some areas of southern Utah; however, no mention of these activities in the vicinity of the Park is documented. Kelly (1951:3) claims that a band of Paiute utilized "Fish Lake as their summer hunting ground, wintering in the vicinity of Koosharem" (cf. Euler 1966:31). Other small groups of Paiutes were believed to have occupied winter camps near the mouth of Pleasant Creek and on the south slope of Boulder Mountain and in the vicinity of the current town of Escalante.

The material remains of the activities of these groups are not well documented in archeological contexts (Euler 1964). Euler (1966:114-115) and Kelly (1964) have, however, compiled ethnohistoric and ethnographic notes describing the material culture and features associated with residential camps. Archeological sites attributed to these Numic-speaking groups are most often defined by Desert side-notched and Rose-Springs projectile points and thick, coarse-tempered, very fragile brownware pottery (Jennings 1978:235-237). In 1969, a cache of material attributed to Numic-speakers was discovered in a side canyon north of the San Rafael River. The material consisted of a large leather bundle containing fragments of bifacially- flaked tools, bone tools, a leather bundle of ochre, and a pouch of dried seeds or squawbush berries. Leather from the bundle dated to 650+50 B.P. (Benson 1982).

In 1874, Brigham Young sent George W. Bean to explore and assess the Capitol Reef area for settlement. Bean visited Fish Lake northwest of the Park and contracted a treaty with the Paiutes there. Within the next few years settlers were wintering cattle in the area along Pleasant Creek and Rabbit Valley (Kelly 1951:8-9). Aboriginal utilization of what is now the Park ended

as a result of this Euroamerican settlement and grazing activities.

Since Noel Morss reported on the archeological investigations during the late 1920s in what is now the Park, archeologists have continued to acknowledge the importance of prehistoric remains in the Fremont River drainage. Current Park boundaries stretch well to the north and south of this drainage; however, as this review of archeological investigations in the area demonstrates, those remains of prehistoric activities within the Park boundaries are of major importance to understanding of the long-term human land use of this environment. Unfortunately, knowledge of the extent and context of these remains is, as yet, far from adequate. Systematic research entailing known archeological resources within the Park has all but been non-existent. If, as expected, those archeological remains existing within the Park boundaries are as significant as those near its boundaries, then preservation of these remains is necessary if attempts at explaining the human utilization of this environment through time are to continue.

History of Grazing

The history of the cattle industry in the Capitol Reef area spans over a century. Cattle probably first entered Utah with the Escalante party in 1776. The true beginning of a cattle industry in Utah began with the arrival of the Mormons in 1847 to the Great Salt Lake. The cattle in Utah numbered well over 12,000 by 1850 (Walker 1964:183). As Mormons established colonies in other sections of Utah, they brought their stock with them.

In the late 1870s and early 1880s, Mormon pioneers began to enter the Capitol Reef area of south-central Utah. They moved large herds of horses and cattle from Richfield into Rabbit Valley, about 30 miles west of the Waterpocket Fold. The little communities that would become Fremont, Loa, Lyman, Bicknell, Teasdale, Grover, and Torrey were founded. In about 1878, Franklin D. Young seems to have been the first to leave the Rabbit Valley settlements for the Waterpocket Fold area. Young attempted to homestead at the junction of Sulphur Creek and the Fremont River. Young abandoned the site and in 1880 Nels Johnson staked his homestead there at what would become Fruita (Davidson 1986:11-13) and is today a part of Capitol Reef National Park.

Capitol Reef National Park includes portions of Garfield, Wayne, Emery, and Sevier counties. Most of the Park, except for the extreme northern extension, lies within Wayne and Garfield counties. In 1890, a census of neat cattle on farms (United States Bureau of the Census 1895:310) reported that 5,382 cattle grazed in Garfield County and that no cattle grazed in Wayne County. By 1900, the cattle numbered 11,323 and 6,095 in Garfield and Wayne counties, respectively (U.S. Bureau of the Census 1902:486).

What few people ventured east into the Waterpocket Fold area from Rabbit Valley settled along the Fremont River. Resources, such as water and arable land, along the Fremont River area were more plentiful than in other areas along the Waterpocket Fold. Gradually, settlers moved along tributaries of the Fremont, especially along Sulphur Creek, Pleasant Creek, Sandy Creek and its tributary Oak Creek. A few hardy adventurers and their livestock entered what is now Capitol Reef National Park from the Halls Creek area at the Park's southern limits. The Hole-in-the-Rock expedition of 1879-1880 had opened up southeastern Utah for Mormon colonization with the founding of Bluff. The Hole-in-the-Rock expedition crossed the Colorado River downstream from where Halls Creek empties into the Colorado. Glen Canyon National Recreation Area now contains some of the most famous segments of the Hole-in-the-Rock route.

Charles Hall built the ferryboat that carried the pioneers across the Colorado River after their tortuous descent at the Hole in the Rock. Hall operated a ferry at that crossing through 1880. The route to the crossing was so rugged that few attempted

it. Hall scouted for and finally found an easier route across the river 35 miles upstream at what is now called Halls Crossing. It was located just above the mouth of Halls Creek (Crampton 1983:111). Hall then located the east and west routes to Halls Crossing from the Hole-in-the-Rock Trail. The west route entered what is now Capitol Reef National Park when it descended from the Circle Cliffs to Halls Creek through Muley Twist Canyon. Muley Twist Canyon received its name from these early pioneers whose mules had to twist to pull the wagons through the narrow, winding canyon (Crampton 1983:111). Charles Hall operated the ferry from 1881 to 1884. The completion of the Denver, Rio Grande, and Western Railroad across Utah in 1883 ended the need to make the long trek across canyons. This route into the Waterpocket Fold and Halls Creek is known as the Halls Crossing Pioneer Trail (United States Department of the Interior 1982:65). Although used only briefly, the trail opened the Halls Creek and Muley Twist Canyon areas to prospectors and ranchers.

The Baker Ranch was located on Halls Creek six miles from Halls Crossing. The waters of Lake Powell inundated the Baker Ranch. Charles Hall maintained a ranch two miles above this. Hall, however, did not have many livestock. At the Baker Ranch, up to 100 acres of pasture alfalfa and corn were irrigated from waters diverted from Halls Creek in the spring. Farming was only an adjunct of grazing. The Baker Ranch was worked from 1900 until 1940. The Bakers later sold the property to other interests who continued to use the ranch as a grazing headquarters until the filling of Lake Powell (Crampton 1962:58-59). The cattle of the Baker Ranch ranged up and down Halls Creek and probably entered what is now Capitol Reef National Park, five miles north of the Baker Ranch site. Cattle may also have been driven down Halls Creek to the Baker Ranch. Rustlers used Halls Creek and, perhaps, Muley Twist Canyon as drive routes. Cattle roamed in the southern portions of Halls Creek not long after they were first moved along the Fremont River with the establishment of Fruita and other communities.

Ranching was not the only activity to introduce livestock to the Halls Creek area. Gold fever infected Glen Canyon and San Juan Canyon between 1883 and 1911. Prospectors brought their horses and mules up and down Halls Creek to supply placer operations on the Colorado River. The tributaries of Glen Canyon were all prospected from mouth to head (Crampton 1959:30-38). Some of these prospectors may have left their names carved at 42GA456.

The rockshelter at 42GA456 lies just south of the confluence of Muley Twist Canyon with Halls Creek. A number of inscriptions at that archaeological site date from 1906 to 1911. Another rockshelter, 42GA651, along Oyster Shell Reef bears inscriptions from this same period. Horses and mules trudged down Halls Creek with supplies for the Henry Mountain Oil Company in 1920-21 (Crampton 1959:63). Perhaps some of these early oil men explored the side canyons of Halls Creek as did the ranch hands at Baker Ranch. In Muley Twist Canyon, many inscriptions on the wall of

42GA459 date to the 1920s. Carlyle Baker, son of Eugene Baker after whom Baker Ranch was named, left his name there in 1924. The dozens of other inscriptions dating to the 1920s at the site give some indication of the amount of traffic up Halls Creek and into its side canyons (cf. Appendix III).

Livestock grazing began in the Capitol Reef area in the 1880s. With grazing came great vegetation changes prior to the turn of the century (National Resource Council 1984:11). As their inscriptions document, by the early twentieth century, cattlemen and prospectors had left more than footprints at archaeological sites in Halls Creek and Muley Twist Canyon.

Grazing continued in the Waterpocket Fold area in the early twentieth century. Although Baker Ranch was abandoned in 1940, other ranchers continued to use it as a base of operations in the Halls Creek area (Crampton 1962:59). Overgrazing became such a serious problem that, from 1939 until 1941, the Hanksville camp of the Civilian Conservation Corps reseeded 18,000 acres of rangeland in the area (Richfield Reaper, October 16, 1941, cited in Baldridge 1971:279).

Some land, however, was removed from grazing. In 1937, President Roosevelt proclaimed 37,000 acres as Capitol Reef National Monument. The Monument was centered around Fruita along the Fremont River. All grazing was eliminated from Monument lands by 1941. After an addition in 1958, Presidential Proclamation 3888 expanded Capitol Reef National Monument to over 250,000 acres in 1969. Public Law 92-207 established Capitol Reef National Park in 1971. This law called for the phase out of grazing privileges over a 20 year span. Public Law 97-341, passed in 1982, interrupted the phase out process by calling for a series of studies over a ten year period to assess the effects of livestock grazing on Park resources (see Henderson 1985 for a history of legislation).

Henderson (1985:8) reports that current use of the Park allocates just over 177,000 acres for grazing. This acreage has been divided into 18 grazing allotments. These allotments account for 5,341 AUMs within the Park. From 1980 to 1984, between 70 and 79 percent of this total was used (Henderson 1985:8). Most grazing within Capitol Reef has been by cattle with secondary livestock values for sheep (about 50 AUMs) and horses (about 60 AUMs). However, use by sheep and horses has almost stopped (United States Department of the Interior 1974:76). The Park has served, principally, as winter range with most cattle transported into the area between mid-October and late November and remaining until April or May (National Research Council 1984:14).

Table 1 illustrates recent use in grazing allotments that fall completely or partially within the Park.

Table 1. Allotment acreage and used AUMS
(adapted from Henderson 1985:10)

ALLOTMENT	PARK ACRES	USED PARK AUMS '84	'83	'82	'81	'80
Cathedral	11,688	300	195	181	194	165
Chimney Canyon	620	38	38	0	0	0
Circle Cliffs	3,200	105	129	149	152	154
Dry Bench	14,027	0	0	0	0	0
Hartnet	67,440	1639	1476	1319	1295	1322
Meeks Mesa	1,824	0	0	0	53	0
Miners Mt.	6,050	41	44	47	65	47
Moody	600	13	10	15	13	15
Muley Twist	13,224	481	481	439	316	276
River	500	7	7	7	7	1
Rock Springs	2,741	76	114	91	99	127
Sandy I	13,436	276	306	271	313	321
Sandy II	8,140	289	289	289	289	284
Sandy III	18,556	736	411	736	736	736
Sleeping Rainbow	3,360	0	0	0	0	0
Torrey Town	1,900	0	27	0	0	0
Wagon Box Mesa	2,240	29	23	42	28	34
Waterpocket	7,495	299	234	240	204	270

Livestock use in Capitol Reef National Park has had a long history. Little information is available about early livestock use in the North District of the Park. However, the remains of cabins of a line camp in Cathedral Valley testify to the early use of that area as well. Along the Fremont River and down Halls Creek, cattle and cattlemen have left their mark. Water has been the most scarce and most valued resource in this desert environment. It comes as no surprise then that prehistoric site patterns and historic ones often mirror each other here. In Halls Creek and Muley Twist Canyon and in much of Capitol Reef National Park where intermittent streams and water pockets in slickrock are the only water sources, living creatures, humans and cattle, migrate to these sources. Each reuse of an area masks or even destroys evidence of the previous use.

Archeological Disturbance Studies

The artifacts recovered in an archeological context have been subjected to a variety of cultural and natural processes. They may have been buried, exposed, reused, transported, deposited, and buried once again. Archeologists assume that artifacts reflect the behavioral and organizational properties of an adaptive system. In order to place the artifact in a systemic context, archeologists must identify and take into account these formation processes. Clearly, any attempt to identify activity areas based on the clustering of artifacts must first identify whether noncultural formation processes were responsible for this clustering. "It is surprising that very little attention has been paid to the human and natural processes which can destroy or change culturally created patterns of artifact distribution" (Rick 1976:133). The following discussion summarizes some of the many works that identify effects of formation processes. Those studies of the specific damage caused by trampling to artifact distributions receive special emphasis at the end of this section.

Wood and Johnson (1978) discuss a number of disturbance processes that affect archeological site formation. They survey disturbances to the context of archeological deposits rather than to the artifacts themselves. They review the effects of such processes as soil formation, faunalturbation, floralturbation, cryoturbation, graviturbation, argilliturbation, and so on. Wood and Johnson emphasize that soils form dynamic systems into which cultural materials are introduced. Wildesen (1982) in a summary of disturbance processes focuses on impacts to archeological sites. Wildesen reiterates impacts caused by some of the geomorphological processes listed by Wood and Johnson. In addition, she adds discussions of damage caused by grazing, chaining, mixing of deposits, fire, erosion, and vandalism.

In their articles, Wood and Johnson and Wildesen concentrate on factors, both cultural and natural, that affect artifacts or their context after deposition. An important, and often overlooked, source of disturbance of archeological materials may be the site's inhabitants. Continued occupation or reoccupation of a site may cause significant vertical and horizontal movement of materials. Matthews (1965) addresses the impact that humans may have on an archeological site as they continue to occupy that site. As people continue to inhabit a site, their movement, the digging of hearths or postholes, and the scavenging of animals will disturb deposits at the site. The result will be the mixing of deposits. Matthews reasons that the mixing of materials decreases with depth with a zone of perhaps 30 centimeters affected. He, however, does not offer any quantitative data to support his mixing theory. In two articles, Stockton (1973 and 1977) discusses a number of Australian sites where the mixing of European and Aboriginal artifacts, the mixing of radiocarbon ages in one cultural stratum, or the distribution of charcoal pieces of similar age through a number of cultural deposits all indicate

vertical movement of materials. Stockton (1973 and 1977) concludes that both "treadage and scuffage" resulted in movement of materials. Treadage by inhabitants at the time of deposition or by later occupants of the same site results in vertical movement of artifacts. Archeological deposits in a sandy matrix are particularly prone to vertical displacement (Stockton 1977:51). Scuffage results in horizontal movement of artifacts (Stockton 1973:116). Hughes and Lampert (1977) also examine Australian sites. They contrast archeological deposits in a sandy matrix with those deposits capped by tightly packed shells. In those cases where materials such as shell bind a layer, the underlying archeological deposits escape the vertical disturbance suffered by archeological materials in sandy layers (Hughes and Lampert 1977:139).

The authors of the studies discussed above restrict their examinations to archeological deposits after burial. Gifford (1978 and 1980) employs ethnoarcheology and taphonomy to examine the more common noncultural processes affecting archeological material prior to burial. Gifford and Behrensmeyer (1977) studied a campsite that was occupied in 1973 by members of the Dassanetch tribe of northern Kenya. Gifford plotted the surface scatter immediately after the site was abandoned. She then revisited the site after two floods. In 1974 the central area of the site was excavated to determine the series of depositional events and to assess how these events had altered original patterns and relative numbers of various components of occupation debris. The excavation recovered many more bones than were plotted by Gifford after the site's abandonment. At the time of the creation of the site, the trampling of the loose sand by the site's occupants caused a size dependent sorting of animal bones into surface and subsurface components (Gifford and Behrensmeyer 1977:257).

Gifford (1980) discusses an interesting observation made on the basis of her studies of the Dassanetch. Short-term Dassanetch occupations are often located in or near shallow ephemeral streams and washes where the potential for sedimentation is good. Isaac (1967) notes that many Acheulian camps are located in a sandy substratum characteristic of shallow ephemeral streams and washes. In contrast, the Dassanetch locate their semipermanent settlements in areas of minimal potential for disturbance. Consequently, the short-term Dassanetch occupations have a relatively higher probability of preservation than do the longer term ones. Because different site types are located in different depositional environments, the archeological sample may be skewed. Obviously, an understanding of past geomorphic processes must be used to develop a settlement pattern model for a region.

Many different disturbance processes work to alter the relationship between archeological materials. Rolfsen (1980) outlines the effects on artifact position caused by freeze-thaw and wet-dry cycles and by plants and animals. He refers to European sites where each one of these factors may have been

responsible for displacement. Wymer (1976) cautions archeologists that they must determine the nature of the sediments at a site. Artifacts found in a river gravel deposit were eroded from another source. Only if the archeological material lies in a primary context can archeologists make meaningful assumptions about artifact associations. Based on laboratory experiments in which artifact dispersion in Kalahari Sands was studied, Moeyersons (1978) concludes that at the Gombe site in Kinshasa, Zaire, the activity of termites and worms caused repeated mantle consolidation. The consolidation resulted in a vertical dispersion of artifacts of distances greater than one meter. Even the type of soil in which archeological materials are found may be the cause of vertical displacement. Vertisols are an order of soils that form from a number of parent materials, but, principally, from montmorillonite clays. Duffield (1970) warns that the dramatic expansion of Vertisols in a wet cycle and the subsequent contraction from desiccation can result in the churning of archeological features and the heaving of artifacts.

Siiriainen (1977) develops a model to explain artifact distribution in a rockshelter in Kenya. In his model, artifacts from three successive occupation periods fell into cracks in the soil. Smaller pieces penetrated deeper than larger ones. Because artifacts from the oldest occupation period had more time to sort themselves, their vertical distribution was the widest. The artifacts from the youngest occupation remained closest to the original horizontal grouping. If the cultural deposits were excavated in nine arbitrary layers of equal thickness then their distribution corresponds closely with that of the artifacts from the River Rockshelter in the Laikipia District of Kenya. Siiriainen (1977:353) concludes that even though his hypothesis for vertical distribution cannot be used to define the precise occupation levels, the vertical selection process taking place within the deposits must be taken into consideration before reconstruction of patterns of prehistoric use can begin.

Slope is also an important factor. Rick (1976) observes that downslope movement on an archeological site may account for heterogeneity in artifact distribution. He develops a critical angle for downslope movement below which horizontal distributions may produce culturally significant information. This critical angle is particular to his study area in Peru. Fuchs and others (1977) test the "rolling down" theory that heavier artifacts will be concentrated downslope on two open air sites in Israel. They demonstrate that slope does not cause artifact clusterings at either site (Fuchs et al. 1977:179).

Baker (1978) and Kirkby and Kirkby (1976) challenge the traditional assumption that surface artifact collections are representative of a site's total artifact inventory. Baker (1978) examines the operation of the size effect on five sites. The size effect results in large artifacts being disproportionately represented at the surface. One or all of the following factors may explain this phenomenon: large artifacts

are less easily buried and more easily uncovered; small artifacts may have been trampled into the subsoil; large artifacts are less portable; and large artifacts could have been scavenged from earlier deposits because of their visibility and reused. Freezing and thawing of soils, rodent activity, and tree root disturbance are additional factors that may accelerate or inhibit the operation of the size effect.

Kirkby and Kirkby (1976) study sherd accumulations at sites in southern Mexico and southwest Iran. Using mound profiles, they are able to estimate relative ages of small mound sites within a given area. They also conclude that surface sherd scatters undergo three processes: accumulation during mound erosion, breakdown from trampling, and movement. These processes affect surface sherd concentrations by first increasing them and then decreasing them exponentially. This exponential decrease of sherd concentrations results in the ever decreasing probability of recognizing a site by surface survey. Kirkby and Kirkby (1976:252) estimate at what age sites in Oaxaca would no longer be recoverable unless they had been reused. The work of Kirkby and Kirkby has important implications for reconstruction from surface data of cultural patterns through time because their work indicates that evidence from the earliest periods may be absent. Studies such as those discussed above should encourage others to identify what factors could control artifact distribution and to examine how these factors can be taken into account in an attempt to reconstruct the original organization of the site.

Evidence for postdepositional movement must first be found before factors to explain it can be enumerated. Numerous examples of postdepositional movement of artifacts rely on the technique of the conjoining or refitting of pieces. The refitted pieces are assumed contemporaneous. Refitting of worked stone at the Gombe site (Cahen and Moeyersons 1977; Moeyersons 1978) reveals a vertical distance of sometimes more than one meter between joined pieces. Hofman (1986) refits pieces from the same lithic reduction sequence. These pieces can be presumed to have been produced and deposited on the same surface. At the Cave Spring site in Tennessee, refitted pieces differ in depth by up to 40 cm. As a result of the refitting, Hofman collapses the materials at the site into a single depositional layer affected by a number of disturbance processes. These processes include shrinking and swelling of clayey sediments, collapsed roots, tree throws, faunalturbation, and freeze-thaw action (Hofman 1986:167). Refitted pieces from the Meer II site in Belgium (Cahen et al. 1979; Van Noten et al. 1980) span 40 cm in depth. Rowlett and Robbins (1982) use coin molds at an Iron Age site in Luxembourg as their refitting aids. They estimate what proportion of the assemblage moved vertically between the last deposition and archeological excavation. With these proportions, they then estimate the original content of assemblages.

Villa (1982) presents perhaps the most disturbing results of refitting. She looks at four Old World sites, Gombe Point, Meer II, Terra Amata, and Hortus. The results of refitting at Gombe

and Meer have been presented above. At Hortus, remains of a single wolf are scattered through eight separate layers over a vertical spread of about one meter. Teeth and jaw fragments from the same Neanderthal individuals cross four or five layers and almost 50 cm in vertical distance (Bordes 1972).

Villa (1982:280-285) focuses her discussion on Terra Amata at Nice, France. As de Lumley (1969) presents the results of excavation at Terra Amata, there can be no question that the stratigraphy of different cultural levels seems distinct with pebble lenses between layers of silty sand, a pebble beach in a sandy matrix, and an upper layer of dune sands. Villa refit 4.8% of the total artifact assemblage. Forty percent of the conjoined pieces fell in different levels. The conjoined pieces even crossed geologic strata. For instance, artifacts found in the dune sands conjoined with others in the pebble beach, and artifacts from the lower sands conjoined with pieces in the beach deposits. In contrast, the horizontal dispersal was very limited (Villa 1982:282). Terra Amata has become a textbook example of a multi-component archeological site. Villa's efforts to reexamine the site lead to the disturbing conclusion that strata that appear to be distinct geologically may hold artifacts from the same occupation. Her work has serious consequences for plausible interpretations of stratigraphic successions at most multi-level sites. "Unless proven otherwise, layers and soil should be considered as fluid, deformable bodies through which archaeological items float, sink, or glide" (Villa 1982:287).

Refitting has been used by others to analyze reliability of context in the archeological record (see Bunn et al. 1980 for refitting of bone; Myers 1958). Refitting is only one of many approaches that can aid in the resolution of contextual and other archeological problems (e.g., see Binford (ed.) 1977; Binford 1981). Much work remains to identify the full potentials and limitations of refitting studies. Refitting is not an end in itself. Instead, it serves merely as a tool in the attempt to build increasingly sophisticated models of past behavior in adaptive systems.

Refitting aids in the recognition of horizontal and vertical displacement of artifacts. The above discussion lists a number of sites where vertical displacement is evident. Often, however, the causes of this displacement are not identified (e.g., see Villa 1982:282). Some authors try to identify causes of vertical displacement by the study of factors in the laboratory (Cahen and Moeyersons 1977; Moeyersons 1978). Wetting and drying cycles, frost conditions, different sediment types, alluvial environments, and so on can be replicated in the laboratory and their effect on artifacts studied.

The effects of human trampling on site deposits at the time of deposition are discussed above. A number of experiments have been designed to study the effects of human trampling either at the time of deposition or after deposition. Flenniken and Haggarty (1979) created lithic scatters using obsidian in five

box compartments in the laboratory. Each compartment contained a different matrix, such as sand, clay, and/or gravel. After walking over the surface of the box, they then collected all of the debitage. They reported results only for the loess matrix. Flenniken and Haggarty's primary interest is the edge modification caused by trampling. Thirty-seven percent of the flakes recovered were modified. They conclude that human trampling can and does have a considerable impact on flake edges and can lead to misinterpretation of archeological data (Flenniken and Haggarty 1979:213). Knudson (1979:280) in an assemblage created by cattle trampling bottle glass notes that archeologists need to be more careful in their designation of lithic "tool" because of the edge modification that trampling may cause. These results contrast strikingly with that of Tringham and others (1974) who conclude that edge damage resulting from trampling is readily distinguishable from the damage resulting from deliberate usage.

Gifford and others (1985) established two experimental sites, one on sand and the other on loam, to study the effects of human trampling. They conclude that human trampling can, indeed, cause substantial downward migration of objects in loose, sandy substrates. Artifacts disperse more horizontally than vertically in the loam. Variations in substrate, in the intensity of human activity, and in resulting interactions of objects, both with the substrate and with each other, produce disparate distributions and damage patterns (Gifford et al. 1985:817).

Kirkby and Kirkby (1976) measure the breakdown of sherds of different sizes when the sherds are walked on. From this experiment, they calculate a rate of breakdown of sherds. This rate will decline through time as well as with smaller sherds. They then develop a model of the frequency of sherds on the mound surface through time using the rate of sherd breakdown and the rate of mound erosion. From this model, Kirkby and Kirkby (1976) can give relative ages of mound sites in an area. Stockton (1973) reports on the effects to buried glass when the glass was walked on. The result seems to be that the glass is sorted by mean weight with depth. Villa and Courtin (1983) also test the vertical dispersal caused by trampling. They placed their experimental plots on the backdirt piles at the entrance to the archeological site at Fontbregoua Cave in France and let excavators walk over them in the course of daily cave excavation activities. Villa and Courtin note significant vertical displacement caused by the trampling with some horizontal displacement. Villa and Courtin's experiment demonstrates that experimental plots to study the effect of formation processes can be set up in the course of standard archeological activities. Inordinate amounts of time need not be spent in pursuit of these studies. Rather, archeologists can easily integrate these studies into their projects.

The effects of livestock and wild animal trampling on archeological sites can be devastating. The introduction for this volume reports on a few instances where animal trampling

modified artifact assemblages, destroyed part of the archeological record, or distorted that record. McBurney (1960) identifies the "Khargan" stone tool assemblage in Libya and Lower Paleolithic/Acheulian artifacts at Sidi Zin in Tunisia as having been modified by animal trampling. Lynch (1974) notes that "artifacts" of the Chiqui lithic complex in Chile seem to result from the trampling of animals trailed through the sites. Knudson (1979) concludes that the edge modification that resulted from cattle trampling could be misinterpreted as intentional without sufficient care.

Other instances of animal trampling damage to archeological sites have been documented. Honeycutt and Fetterman (1985) note disturbances at Alkali Ridge caused by cattle trampling the ground. Martin and others (1983) conclude that a high amount of attrition and other wear noted on surface lithics at the Cedar Siding Rockshelter in east-central Utah are due to postdepositional factors such as "disturbance by hooved animals moving across the site" (Martin et al. 1983:106).

Systematic study of the effects of animal trampling on archeological sites is just beginning. Keller (1984) reports the intention to study the impact from a new cattle grazing program to ten sites in pinyon-juniper woodland and grassland near Ash Fork, Arizona. Van Vuren (1982) set up five simulated sites. On each site, he marked a 1 x 1 meter square and distributed eight flakes around the square's perimeter. Three of the sites were established in areas of high feral sheep density on Santa Cruz Island. Two control sites rested in an area of low sheep density. Van Vuren monitored the plots each month for six months. After six months, he raked the site area to expose buried flakes. By the end of the six months, two-thirds of the flakes could not be relocated and the others were out of their original position at the three plots in the the high density areas. The control plots had lost only six percent of their flakes.

Work at the Naval Weapons Center, China Lake, California, (Naval Weapons Center 1981) documents the severe impact feral burros have on archeological sites. Experimental plots, one a test plot and the other a control plot, were set up to study the horizontal and vertical displacement caused by the burros. Results of the study of the plots are not yet available. Archeological sites on Naval Weapons Center property were examined for evidence of disturbance by the feral burros. All of the 23 sites located during fieldwork show negative impacts. The cause of these negative impacts at ten of the sites can be positively attributed to feral burro activities. Negative impacts are greatest in areas where burros congregate. These areas tend to be at springs. Springs are also the areas in the desert west with the greatest concentration of historic and aboriginal materials. Thus, the areas of heaviest burro impact often coincide with the areas of richest cultural resources. The devastation to the cultural debris at these heavily trampled areas cannot be overemphasized.

Roney (1977) discusses the effects of trampling by cattle to an open lithic scatter. Roney placed ten obsidian nodules and fifty obsidian artifacts within a 4.5 meter by 2.0 meter area in a portable corral. Cattle remained within the corral for a total of 1311 bovine hours. Roney (1977:2) calculated this hour total to be equivalent to 12 years of grazing at one cow per 20 acres. Roney then provenienced surface artifacts and excavated the area. He recovered eight of the ten nodules and forty-eight of the fifty artifacts. Roney observed moderate to severe damage on thirty-eight percent of the obsidian artifacts. The horizontal displacement was less severe than Roney anticipated. Vertical movement of the artifacts left only 3 of the 70 or more nodules, artifacts, and artifact fragments on the surface (Roney 1977:15).

Trampling by animals can affect archeological sites in many ways. Obviously, it modifies artifacts and causes horizontal and vertical displacement of them. Trampling skews the surface assemblage by pushing smaller artifacts into the substrate and reduces the visibility of the archeological site by pushing artifacts into the substrate. In Roney's (1977) experiment, four percent of the assemblage remained on the surface after trampling. The "site," thus, became dramatically less visible. Overgrazing by livestock increases the erosion potential of the site and, thus, increases the opportunities for postdepositional movement of artifacts. Animal trampling compacts the soil (see Knoll and Hopkins 1959) which alters the character of sediments in an archeological deposit as well as the relationships between artifacts. Animal dung increases the phosphate content of the soil and so may distort phosphate samples taken from an archeological site (Bakkevig 1980). In addition, concentrations of animal dung, particularly in rockshelters, increase the fire potential. Fire alters the morphology of stone artifacts (Wildesen 1982) and skews the results of dating techniques.

Whenever an archeologist makes an inference, that archeologist has inevitably made assumptions about the nature of formation processes. Inappropriate assumptions cannot long survive. They must be exposed and replaced by thoughtful efforts to understand how specific deposits formed. Studies such as those outlined above did not, for the most part, offer quantitative measures of disturbance. Studies that offer such measures are essential if middle-range theory for formation processes is to continue to develop. Without such studies, archeologists cannot claim any behavioral significance for their inferences. "Archaeologists must be willing to study the effects of disturbance on resources or must resign themselves to the cessation of archaeological fieldwork, since no intact pristine resources will remain" (Talmadge and Chester 1977:5).

METHODOLOGY

Field Methods

Fieldwork for this study consisted of three components: reconnaissance of select recorded archeological sites; establishment of experimental artifact plots; and follow-up observation/monitoring of experimental plots. Initial fieldwork for the first two components began on September 23, 1985, and was completed on October 3, 1985. The third component of this study was completed from June 21 to June 24, 1986.

The first component involved an examination of known sites in the Park in an attempt to evaluate the impact of domestic livestock on prehistoric remains. Records for known archeological sites within Capitol Reef National Park were examined at the Midwest Archeological Center, National Park Service in Lincoln, Nebraska.

The experimental artifact plots were designed primarily to assess livestock impacts on open sites or surface artifact scatters. The first component attempted to evaluate livestock impacts to archeological sites in shelters. Rockshelters occur frequently in the Park. Livestock have been known to seek protection in rockshelters. Such natural settings served to concentrate the activities of domestic animals and posed potential threats to associated archeological remains. The archeological base map for Capitol Reef National Park was consulted in order to locate several rockshelters that were relatively easily accessible and that could be visited within a limited field period. A number of such rockshelter sites were then located on Park maps in Lower Muley Twist Canyon of the South District. Copies of original survey records made by Lister in 1958, as well as black-and-white photographs and color slides were obtained from the Department of Anthropology at the University of Utah. These records aided efforts to locate rockshelter sites which exhibited evidence for livestock activity.

Two previously undocumented sites in the North District (42WN1651 and 42WN1652) were recorded. Site 42WN1651 required further work in 1986, the results of which will be available in 1987. Appendix III contains the site description of 42WN1652. Also, three days were spent in reconnaissance of Muley Twist Canyon. In addition to one rockshelter (42GA651) in Oyster Shell Reef, five rockshelter sites in Muley Twist Canyon were redocumented and examined for evidence of disturbance by cattle. Additions to Lister's site descriptions and comments on the present condition of the sites are found in Appendix III.

Six of the eight monitored sites exhibited evidence of livestock disturbance. In the North District, the floor of rockshelter 42WN1652 was covered with a layer of cow dung varying from 10 to 20 cm in thickness. Cow dung littered the floors of rockshelters 42GA651, 42GA456, and shelter C of 42GA457. The original site form for 42GA458 noted that cows may have knocked over the upright slabs of a cist. Scattered cow and horse dung covered the floor of 42GA459. Lister's site descriptions mentioned cattle disturbance specifically only at 42GA458 and 42GA459. The brevity of Lister's site descriptions, however, made it impossible to determine how much damage occurred to the Muley Twist Canyon sites between 1958 and 1985. Kay (1973) also did not note the extent of cattle disturbance at 42GA651 beyond the fact that it was evident (cf. Appendix III).

The second component of this study was designed to obtain controlled information regarding the impact of domestic livestock on surface artifact scatters. Unlike the first component, this data was to be derived from experimental situations. Originally, three experimental plots consisting of four contiguous 4 x 4 meter units were to have been established in the Park. These plots were to have been arranged in an L-configuration. With little a priori information regarding the probabilities of a particular area and/or plot being trampled or disturbed by livestock, a major concern became whether any of the plots would be impacted by livestock over the short exposure period of one grazing season. It was initially thought that this relatively large L- shaped plot design would increase the likelihood of "capturing" and monitoring livestock disturbance.

This original plan was changed prior to initiating the fieldwork. Park personnel provided more specific information and suggestions concerning current livestock grazing activities. Such information included the spatial and temporal aspects of grazing patterns. It was critical that the experimental plots be placed in areas that would experience some degree of impact during the interim period.

The decision was made at this time to locate a number of the experimental plots near existing and/or proposed vegetation exclosures established by the Park. It was hoped that this would enable Park personnel to continue to monitor effects to the archeological plots after this study had ended. Consequently, it was decided to reduce the size of the plots and to establish twelve 2 x 2 meter units and one 1 x 1 meter control plot (Fig. 3). This increase in the number of plots would enable investigators to monitor livestock disturbance over a greater area of the Park. The plot locations represented four of the grazing allotments in the Park (Waterpocket, Sandy III, Hartnet, and Cathedral). Because these plots were scheduled to be monitored only once within the year, it was necessary to place plots within areas to be grazed over that winter.

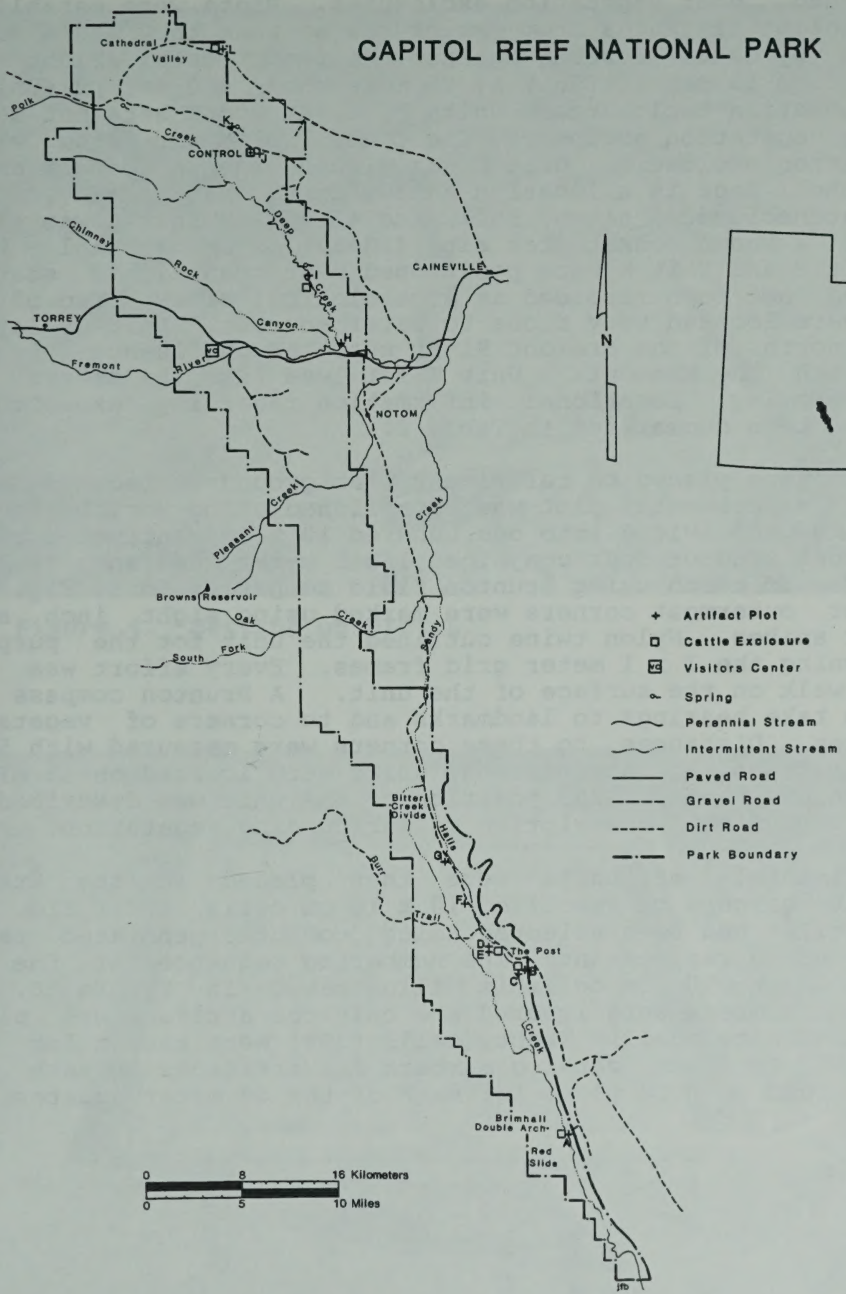

Figure 3. Capitol Reef National Park with locations of artifact plots and cattle exclosures.

Twelve experimental plots and one control plot were placed in five of the 18 grazing allotments in the Park. Eight plots were established near vegetation exclosures. Plots were established at sufficient distances from exclosures so that they would not be impacted by cattle rubbing against the fence posts. Plots were located from 15 meters (Unit A) to more than 400 meters (Unit I) from vegetation exclosures. Units F, G, H, and K were not set up near any vegetation exclosure. The control plot was set up within a vegetation exclosure. Unit F was placed under a hogback on the Oyster Shell Reef in a location analogous to that of many of the Park's archeological sites, including 42GA651. Unit G was placed west of a known rockshelter site 42GA651 on Oyster Shell Reef. Both Unit H and Unit K were positioned near open lithic scatters that had not been recorded as archeological sites. Two of the units were located very close to water sources. Unit H lay 50 meters north of the Fremont River near the confluence of Deep Creek with the Fremont. Unit K sat less than 40 meters from Ackland Spring. Locational information regarding experimental plots has been summarized in Table 2.

Plots were placed on relatively flat ground surfaces. Each 2 x 2 meter experimental plot was established using portable meter grid frames subdivided into one hundred 10 x 10 centimeter cells. Plots consisted of four conjoined 1 x 1 meter quadrants aligned with magnetic north using Brunton field compasses (cf. Fig. 4). The four outermost corners were marked using eight inch steel nails or spikes. Nylon twine outlined the unit for the purposes of aligning the 1 x 1 meter grid frames. Every effort was made not to walk on the surface of the unit. A Brunton compass was used to take bearings to landmarks and to corners of vegetation exclosures. Distances to these corners were measured with 50 or 100 meter tapes. All experimental units were located on 15 minute topographical maps and the position of the unit was described in detail, including a description of surrounding vegetation.

Experimental artifacts were then placed in the extreme northwest corners of specified 10 x 10 cm cells (cf. Fig. 5). These cells had been selected using computer-generated random numbers using replacement. The numbering sequence for the one hundred 10 x 10 cm cells is illustrated in Figure 6. All duplicate numbers were ignored and only one artifact was placed in a designated cell. Twenty cells (20%) were chosen for each quadrant. Artifact catalog numbers for artifacts in each cell were recorded on grid plots for each of the 49 meter squares.

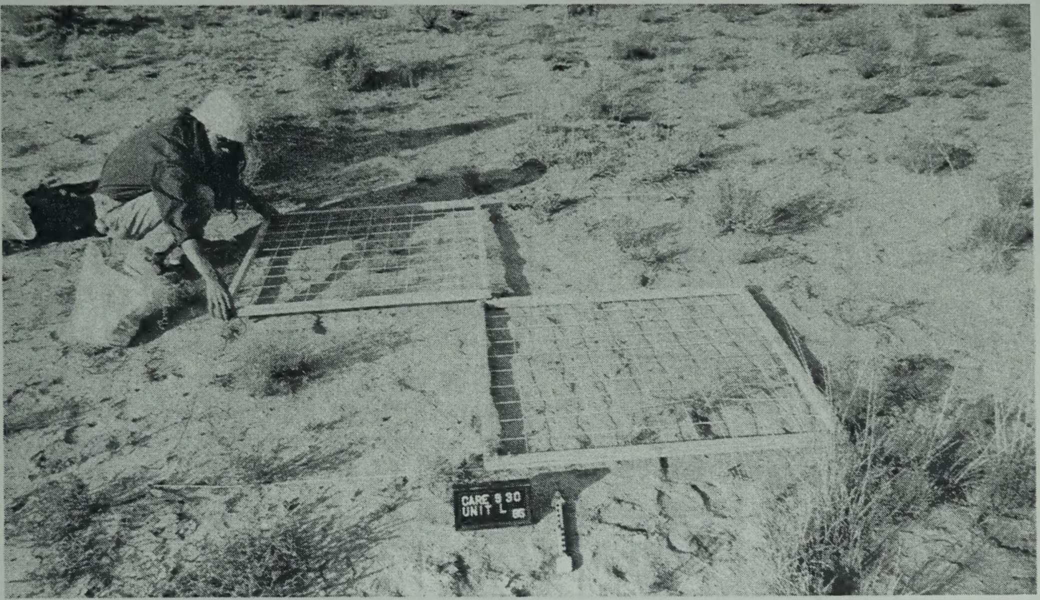

Figure 4. Setting up Plot L.

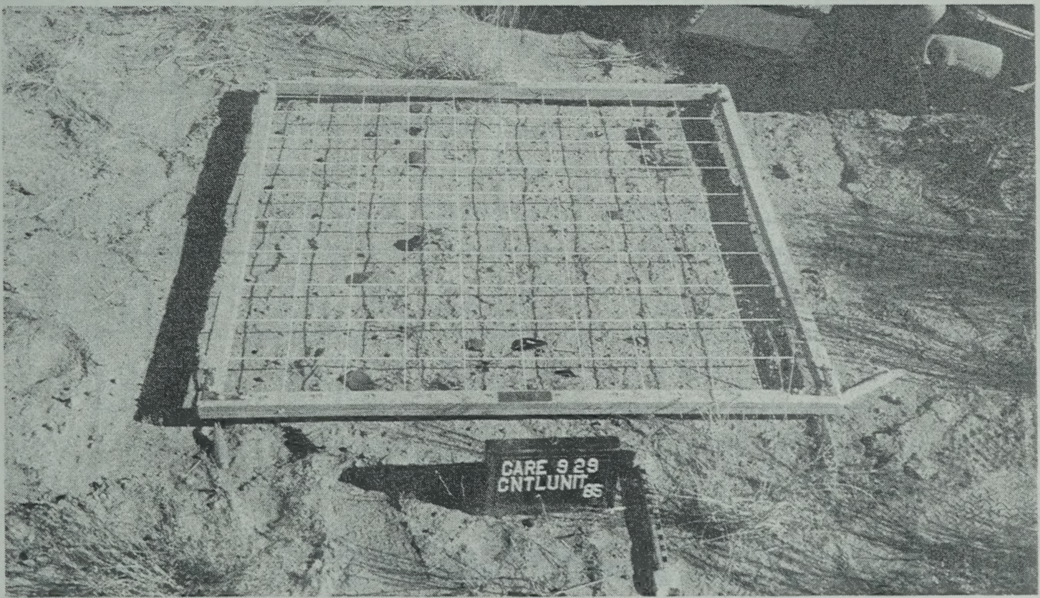

Figure 5. Control Plot with artifacts in place.

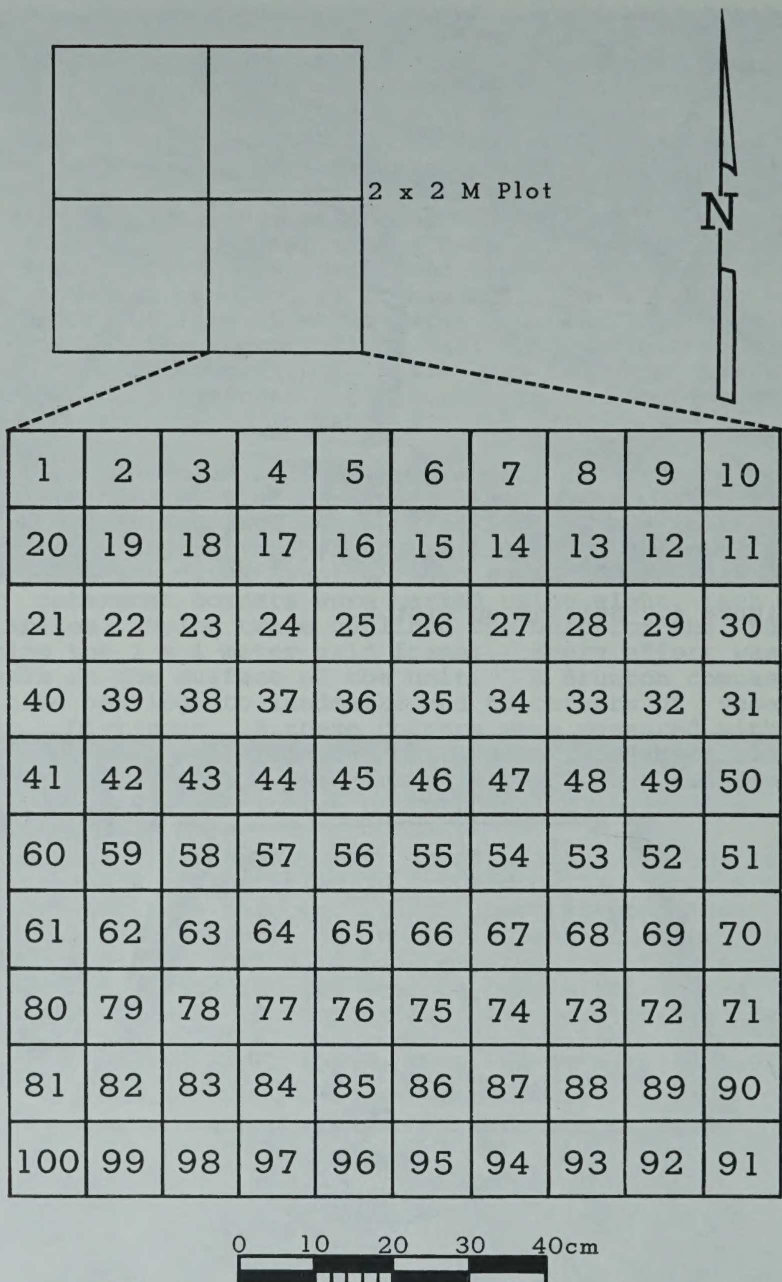

Figure 6. Artifact plot numbering, scale, and orientation.

Table 2. Descriptive information for experimental artifact plots in Capitol Reef National Park.

Unit	Size	Situation	Legal Description (15' Topographic Series)
A	2 x 2	East of proposed exclosure	SE1/4,NW1/4,SW1/4 T36S,R9E,Sec4,Halls Mesa Waterpocket Allotment
B	2 x 2	East of proposed exclosure	SE1/4,NE1/4,NW1/4 T34S,R8E,Sec25,Mt.Pennell Waterpocket Allotment
C	2 x 2	South of proposed exclosure	SE1/4,NE1/4,NW1/4 T34S,R8E,Sec25,Mt.Pennell Waterpocket Allotment
D	2 x 2	West of August 1984 exclosure	NE1/4,SW1/4,NE1/4 T34S,R8E,Sec23,Mt.Pennell Sandy III Allotment
E	2 x 2	Adjacent/South of Unit D	NE1/4,SW1/4,NE1/4 T34S,R8E,Sec23,Mt.Pennell Sandy III Allotment
F	2 x 2	Rockshelter area near Oyster Shell Reef	NE1/4,NW1/4,SE1/4 T34S,R8E,Sec4,Wagon Box Mesa, Sandy III Allotment
G	2 x 2	West of rockshelter Site 42GA651	NW1/4,NW1/4,NW1/4 T33S,R33E,Sec33,Wagon Box Mesa, Sandy III Allotment
H	2 x 2	North of Fremont R. East of Deep Cr.	NE1/4,SW1/4,NE1/4 T29S,R7E,Sec15,Fruita Hartnet Allotment
I	2 x 2	East side Deep Cr. Five miles north of Fremont River	SW1/4,SW1/4,SW1/4 T28S,R7E,Sec28,Fruita Hartnet Allotment
J	2 x 2	East of Hartnet exclosure south of road	SE1/4,SW1/4,NW1/4 T27S,R6E,Sec25,Fruita Hartnet Allotment
Control	1 x 1	Inside Hartnet exclosure	SE1/4,SW1/4,NW1/4 T27S,R6E,Sec25,Fruita Harnet Allotment

Table 2. Descriptive information for experimental artifact plots in Capitol Reef National Park (cont.).

Unit	Size	Situation	Legal Description (15' Topographic Series)
K	2 x 2	North of Harnet Draw road and west of Ackland Spring	SE1/4,SW1/4,NW1/4 T27S,R6E,Sec23,Fruita Hartnet Allotment
L	2 x 2	East of Cathedral exclosure and north of road	SW1/4,SW1/4,SW1/4 T26S,R6E,Sec34,Torrey Cathedral Allotment

A photographic record including black/white and color photographs was kept for each plot. These photographs documented field activities, local settings, and artifact distributions for all twelve plots and the control unit. These photographs aided in relocating several of the plots during the second field visit. The photographs also served to provide comparisons between the 1985 and 1986 condition of the plots. For example, in Plot G the 1986 photograph (Figs. 7,8) revealed the general denudation of the vegetation after the winter grazing season. The surface of Plot L in 1986 bore the imprint of cattle hooves not visible in the 1985 photograph (Figs. 9,10). Finally, the two photographs of the Control Plot (Figs. 11,12) displayed the generally undisturbed character of the artifact positions as well as the desiccation of the surface.

For each unit, the unit's position was located on a topographic map, its setting described, and photographs taken before, during, and after placement of the artifacts. Within the plot, each artifact was placed in the appropriate cell, the artifact catalog number for the cell was recorded on a graph of the grid, and the plot, cell, and material type were noted on the catalog slip for each artifact. The graph and the catalog slip provided duplicate information on the location of artifacts in each grid. After placement of the artifacts in a unit, the crew removed the nylon string from the unit corners. The crew then marked the corner spikes with flagging tape and pounded the spikes flush with the ground. These final steps made the unit as inobtrusive as possible. Time required to set up individual 2 x 2 meter artifact plots ranged from 45 to 90 minutes.

The third component of this study was meant to secure information regarding livestock impacts on the experimental artifact plots. Prior to the return visit to the experimental plots, all photographic and artifact provenience data was organized by 1 x 1 meter quadrant and by plot. A field form was

Figure 7. Plot G, 1985.

Figure 8. Plot G, 1986.

Figure 9. Plot L, 1985.

Figure 10. Plot L, 1986.

Figure 11. Control Plot, 1985.

Figure 12. Control Plot, 1986.

prepared to facilitate recording information about individual artifacts and the character of animal disturbance (cf. Appendix IV).

With the aid of topographical maps and photographs of the plot setting, the field crew relocated the experimental unit. The four outermost plot corners were relocated and the boundaries of the unit were strung. The portable grid frames were then aligned with the corners and the string. One of the four quadrants was selected for collection. All artifacts within the selected 1 x 1 meter quadrant of the 2 x 2 m unit were collected and placed within a bag and its provenience, i.e., cell number, was recorded. Missing artifacts for the selected quadrant were relocated if possible and provenience data was recorded by quadrant/cell or by triangulation from the closest plot corners for those artifacts located outside of the unit. Artifact observations were then recorded for the remaining three quadrants in each of the experimental plots. Care was taken not to move an artifact unless it was necessary to determine its catalog number. The laboratory sketches of each artifact were employed to identify an artifact whose catalog number had been obscured. In those limited cases when an artifact had to be picked up, it was placed in its previous location. No probing or excavation was employed to locate missing items. Displaced artifacts were linked to their previous locations on the grid forms with arrows depicting direction of displacement. If artifact breakage or attrition was readily apparent, this information was also recorded on the quadrant grid plans. The time required to monitor a plot ranged from 45 minutes to 90 minutes.

If the same procedure were followed, the plots could be examined three more times with collection of a 1 x 1 meter quadrant at each examination. As discussed previously, long term studies of the effects of disturbance processes on archeological sites have been rare. Each time these plots were monitored would add significantly to the understanding of artifact breakage patterns, visibility, and displacement due to animal trampling. After all of the artifacts have been collected, the area of each experimental plot should be excavated. Only with excavation could assumptions about the size of debris no longer visible be confirmed.

Laboratory Methods

A total of 980 experimental artifacts were produced for the Capitol Reef grazing study. The artifacts were placed in the 12 experimental plots and one control plot. The artifacts included the following: 572 flakes, 391 ceramic fragments, and 17 lithic tools. These items were produced at the Midwest Archeological Center (NPS) laboratory.

The raw material for the lithic artifacts consisted primarily of obsidian cobbles from Glass Buttes, Oregon, and secondarily of tabular shaped chert from southeastern Utah. Several flakes were produced from a cobble of chalcedony from southeastern Utah and a few flakes were derived from chunks of fused shale from Los Angeles, California. Because material type was not noted in the laboratory and because field identifications were unreliable, the fused shale has been grouped under the "chert" material type category.

A soft hammer percussion technique was used on all lithic raw material samples. The primary objective here was to manufacture numerous flakes in a wide size range. In addition, three obsidian cores and thirteen bifacial and unifacial obsidian tools were produced. The bifacial and unifacial tools were pressure flaked separately from other reduction activity in order to isolate pressure flakes from other debris. Some of these pressure flakes were then collected and included in the study.

The ceramics used in this study consisted of unglazed, commercially produced clay flower pots. Ten of these clay pots were placed in a confined space and broken into various sized fragments. All rim and basal sherds were removed so that sherd thickness remained consistent.

Both the lithic and ceramic artifacts were size graded using a 1.5, 0.5, and 0.07 inch mesh screen. The size grading insured that a wide range of size classes could be selected. Fragments less than 0.01 grams in mass were included. All items selected for the study were then weighed on a electronic metric scale to the nearest 0.01 gram. Labels were drawn on the artifacts on two or more surfaces in the hope that at least one of the labels would remain legible after weathering. Catalog numbers consisted of an alphanumeric code including a letter (A-L) representing the individual artifact plot and a sequential value from 1 to 1000. These numbers were written in India ink against a background of white correction fluid. Each number was then coated with clear lacquer polish. Outlines of the artifacts were then drawn in order that comparisons could be made.

The items from the collected quadrant were returned to the laboratory where they were compared to the outline drawing to determine if damage had occurred. Three types of damage were identified: breakage, exfoliation (ceramics only), and edge

damage. Edge damage was very difficult to assess because the artifacts had to be compared with a trace outline. Collected artifacts were identified as edge damaged if attrition was visibly apparent. Edge damaged and broken artifacts were weighed again on the electronic scale. Comparisons of mass did not prove to be a sensitive enough test to detect edge damage. A complete inventory of artifact types, weights, condition, and provenience has been provided in Appendix I.

RESULTS AND ANALYSIS

The purpose of this section is to assess the degree to which livestock grazing and related human activities affect the character of the archeological record. More specifically, it is concerned with the identification of patterned relationships between cattle trampling and the integrity of surface artifact scatters. These patterns involve differential attrition and breakage and horizontal/vertical displacement of prehistoric remains- particularly lithic tools/debitage and ceramics. Archeologists must continue to develop approaches aimed at the identification of natural processes, e.g., weathering, cryoturbation, and bioturbation (animal disturbance) that have modified archeological remains. Such natural formation processes can then be "factored out" in later archeological studies of past human behavior reflected in the material record.

In the following analyses, attention is focused on three major aspects of artifact scatter integrity: (1) differential post-depositional breakage or edge damage; (2) differential visibility; and, (3) differential horizontal displacement. These analyses make use of field observations concerning both collected and non-collected experimental artifacts. Twelve 2 x 2 meter experimental plots and one 1 x 1 meter control plot were established to monitor these three aspects of surface artifact scatter integrity. A total of 980 artifacts including 572 (58.37%) pieces of debitage, 17 (1.73%) tools , and 391 (39.90%) ceramic fragments/potsherds were distributed in relatively equivalent proportions throughout these plots (cf. Appendix I). A total of 818 experimental artifacts were observed during the monitoring phase of this study (cf.Table 3). These artifacts included 456 pieces of lithic debitage, 14 lithic tools, and 348 potsherds. All percentage figures in the following analyses are ultimately expressed in relation to total visible artifacts unless otherwise specified.

Table 3. General experimental artifact summary for Capitol Reef National Park, Utah.

	Total	Modified	Not Visible	Displaced
Artifacts	# %	# %	# %	# %
Lithic debitage	572 (58.4)	11 (20)	116 (71.6)	129 (56.1)
Lithic tools	17 (1.7)	0 (0)	3 (1.85)	0 (0)
Ceramics	391 (39.9)	44 (80)	43 (26.5)	101 (43.9)
Totals	980 (100)	55 (100)	162 (100)	230 (100)
% Total Artifacts	100	5.6	16.5	23.5

Differential Artifact Modification

Seven hundred sixty-three (93.28%) artifacts were intact. Fifty-five (6.72%) artifacts were broken/modified. Eleven lithic and 44 ceramic items were broken. Eleven pieces of debitage exhibited edge damage or were fragmented. These modified debitage pieces represent 1.92 percent of the original debitage sample or 2.34 percent of the visible debitage. None of the fourteen visible lithic tools were modified i.e., edge damage or breakage. No lithic or ceramic artifacts placed in the control plot exhibited edge damage or were broken.

The observed pattern of artifact breakage indicates that lithic debitage and potsherds are affected differently by domestic livestock trampling. If all visible experimental artifacts exhibited equal probability of breakage, one would expect that a total of 32 lithic items and 23 ceramic fragments/potsherds should be broken. A chi square test revealed that lithic artifacts and potsherds did not exhibit equivalent levels of damage. The null hypothesis was rejected since the calculated chi square value equaled 82.40 and the critical value equaled 10.83 (two- tailed test; df= 1 ; p< .001). In the experimental artifact plots trampled by cattle fewer lithic items (debitage and tools) and more potsherds were damaged or broken than were expected given the null hypothesis.

During the field work, two forms of ceramic breakage were noted. Sherds exhibited either snap fractures or laminar exfoliation. Several sherds reflected evidence for both snap fractures and exfoliation. Initially, the exfoliation breakage pattern was thought to be related to extreme diurnal or seasonal

temperature changes . However, this seems less likely since no potsherds from the control plot had exfoliated. This form of breakage may be due to the uniformity of the modern clay pot paste and the lack of temper.

Another idea regarding the exfoliation versus snap fracture patterns of ceramics relates to sherd size. Since all sherds were of the same relative thickness, sherd weight could be used as a measure of sherd size/surface area. Perhaps the exfoliation pattern might be related in a regular, direct way to sherd size/surface area. Mean sherd weights for each breakage pattern group were calculated. A t-test was performed in order to test the hypothesis that these two forms of breakage were related to sherd size/surface area. Six sherds that exhibited two or more forms of breakage/damage were excluded from this analysis.

Mean weight/size for the exfoliated sherds (N=18) equals 5.16 grams (range= 0.1-22.0 grams; s.d. = 5.89). Mean weight/size for snap fracture sherds (N=20) equals 7.82 grams (range= 0.1-22.0 grams; s.d. = 6.99). The t value equals -1.14766 (two-tailed test; df= 36; p >0.20); therefore, there is no statistical difference between the mean sherd weights/sizes for these two breakage classes. Exfoliation does not appear to occur as a function of increased sherd size.

Differential Artifact Visibility

One hundred sixty-two experimental artifacts were not visible during this monitoring phase. These artifacts included 116 pieces of lithic debitage, 3 lithic tools, and 43 potsherds. The debitage not observed represented 20.28 percent of the debitage originally placed in the plots. One small potsherd in the control plot was not visible. These lithic items varied in weight/size from 0.1-37.1 grams; their mean weight/size is 2.17 grams (s.d. = 4.90). Seventy-nine percent of the debitage fragments not visible exhibited weights equal to or less than 2.0 grams. A linear regression revealed that there is a tendency for greater numbers of debitage fragments to disappear from view as mean debitage weight per plot decreases ($r = -0.3815$; $R= .1455$; $df= 9$; $p>0.10$). The presence of several outliers in this sample probably obscures a more powerful linear relationship in this case. It is possible that further observations might substantiate this relationship.

A total of forty-three potsherds was not visible in the plots. This number represented 11 percent of the original total of 391 sherds placed in the plots and 26.55 percent of the artifacts that were not visible. Mean weight/size for these "invisible" sherds equaled 1.67 grams (range = 0.1-11.1 grams; s.d.'= 2.64). Thirty-three (75%) of these sherds weigh less than 2 grams. This conforms to previous observations regarding lithic debitage weight/size and visibility. Based on these observations, one finds that sherds are more likely to be damaged but less likely

to disappear compared with lithic debitage and small tools.

Differential Artifact Displacement

A total of 230 artifacts (23.5 percent of the original sample) was displaced. This total consists of one hundred and twenty-nine lithic artifacts and 101 potsherds. Four artifacts in the control plot were displaced. This displacement is minimal (less than 2 or 3 cm) in all cases and may, in fact, be attributed to slight misalignment of the grid frame during monitoring (cf. Fig. 21).

Observations from this monitoring phase were also utilized to evaluate the relationship between artifact weight/size and displacement. Artifact data (Appendix I) as well as the artifact plot figures (Appendix II) were used to separate displaced materials into one of two classes: 1). displaced out of cell (DOC); and, 2). displaced out of quadrant (DOQ). Experimental artifacts were initially placed in the northwest corner of select 10 x 10 cm cells within each 1 x 1 meter quadrant. Movement ranging from 2 to 14 cm was classed as "displacement out of cell" (DOC). If the cell was located adjacent to the quadrant boundaries, minimal movement could have led to displacement outside the quadrant or DOQ. However, these cases were few. Artifact plot diagrams (Appendix II, Figs. 1-21) were referred to in order to make the final classification (i.e., "DOC" versus "DOQ"). Movement ranging from 15-141 cm was classified as "displacement out of quadrant" (DOQ). These displacement classes were meant to be two generalized rank ordered measures of displacement.

Initial field observations suggested that larger lithic artifacts tended to be displaced over greater distances than either small debitage or ceramic fragments. Data regarding both collected and non-collected materials were examined to evaluate this intuitive idea. Displaced artifacts were grouped into minimal (DOC) and maximal (DOQ) categories according to experimental plot and quadrants. Raw material category i.e., lithic versus ceramic and artifact weight were also tabulated. The results of this tabulation are provided in Table 4a. Mean artifact weight for material displaced out of cell equaled 8.74 grams versus 19.72 grams for lithic materials displaced out of quadrant. This initially appeared to confirm field observations. Mean ceramic weights for the two displacement categories i.e., DOC and DOQ equaled 5.75 and 6.16 grams, respectively. Ceramic materials did not appear to reflect the same relationship between weight/size and degree of horizontal displacement.

Two t- tests were conducted in order to assess differences between mean artifact weight/size and degree of horizontal displacement. In both instances, no statistically significant differences were indicated for mean lithic debitage or sherd weight/size between minimal (DOC) and maximal (DOQ) degrees of horizontal displacement (cf. Table 4b) .

Table 4 a. Summary statistics for lithic and ceramic artifacts and degree of horizontal displacement (DOC vs DOQ).

	Minimal (DOC)	Maximal (DOQ)
Lithic artifacts:		
Mean Weight (g)	8.74	19.72
s.d.'	18.66	21.56
Number	120.00	17.00
Ceramic artifacts:		
Mean weight (g)	5.75	6.16
s.d.'	6.38	6.25
Number	90.00	14.00

Table 4 b. T-test results for difference of mean artifact weight/size for minimal and maximal horizontal displacement.

Lithic artifacts:	
t-value	0.1495
df	135
p	>0.20 Not significant
Ceramic artifacts:	
t-value	0.2239
df	102
p	>0.20 Not significant

SUMMARY AND CONCLUSIONS

The primary purpose of this study has been to monitor the impacts of livestock and related human activities on archeological resources within Capitol Reef National Park. The results of the monitoring phase of this study are provided in Tables 3 and 5, Figures 13-15, and Appendices I and II. The three major factors monitored are: (1) differential modification (breakage and /or edge damage); (2) differential visibility; and, (3) differential degree of displacement.

First, a total of fifty-five (5.6%) artifacts was broken as a result of livestock trampling within 10 (83%) of the 12 experimental plots. This total number of broken artifacts consists of 11 (20.0%) lithic and 44 (80.0%) ceramic items constituting 1.87% and 11.25% of their respective raw material categories. No artifacts in the control plot were broken or modified. Second, one hundred sixty-two (16.5%) artifacts were not visible during this monitoring phase. As discussed previously, the majority of these items (lithic and ceramic) weighed less than 2 grams. The total number of non-visible artifacts consists of 119 (73.45%) lithic and 43 (26.5%) ceramic items constituting 20.2% and 11.0% of their respective raw material categories. One small potsherd in the control plot was not visible. Third, two hundred and thirty (23.5%) artifacts had been displaced by livestock activity. Fifty-six percent of these displaced artifacts are lithic items and forty four percent are ceramic items. Artifact displacement in the control plot was minimal.

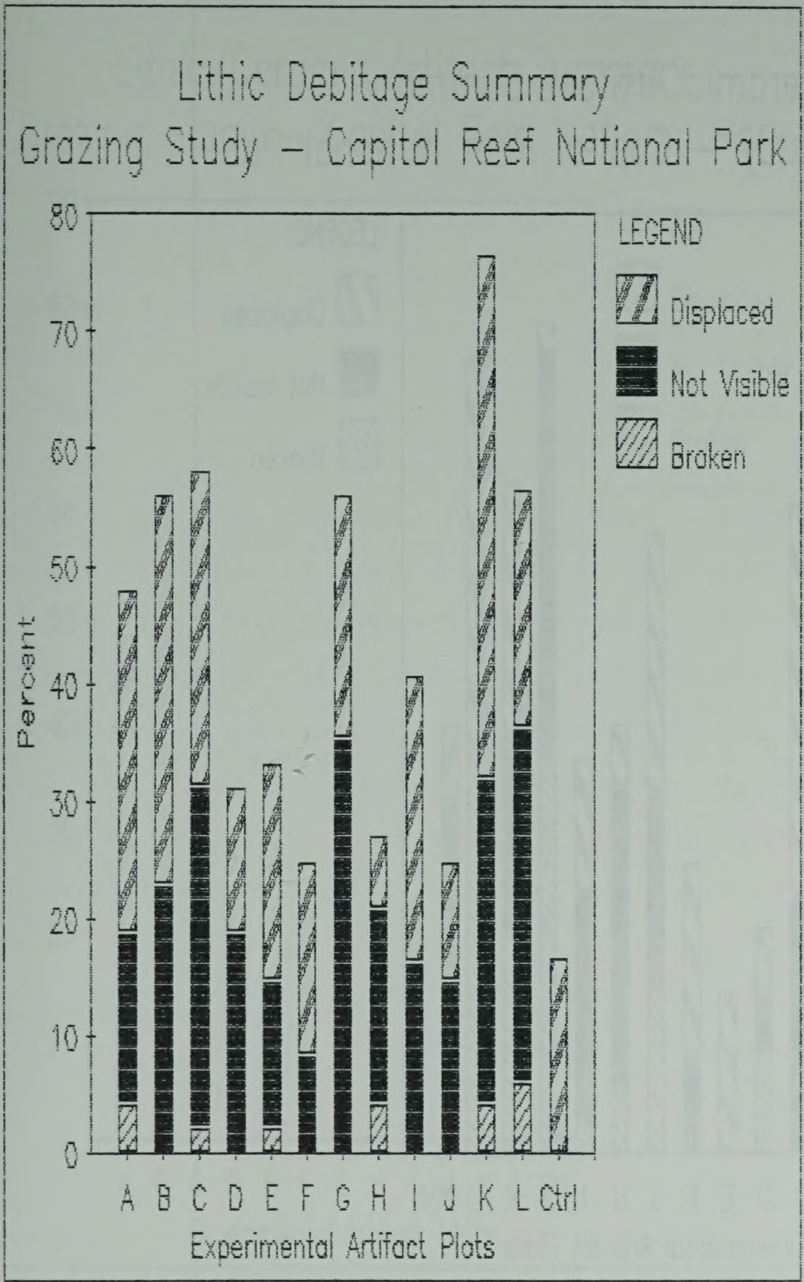

Figure 13. Lithic debitage summary of experimental plots.

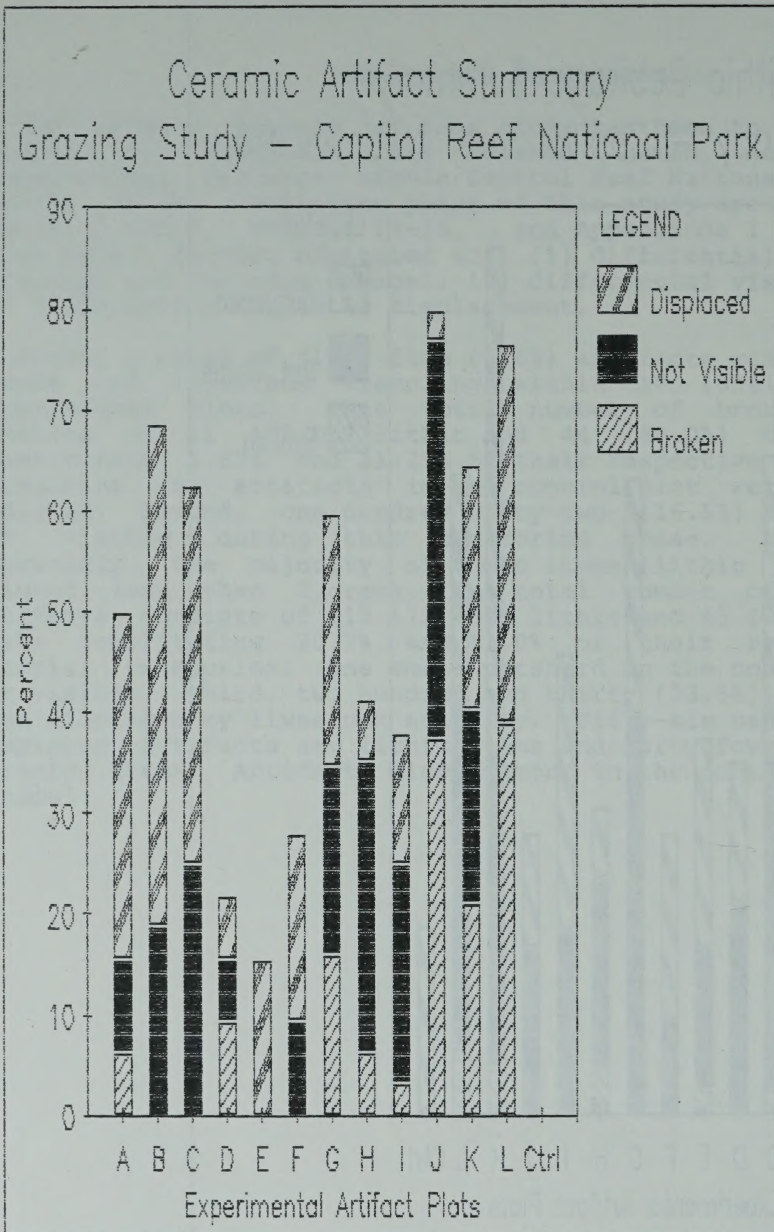

Figure 14. Ceramic artifact summary of experimental plots.

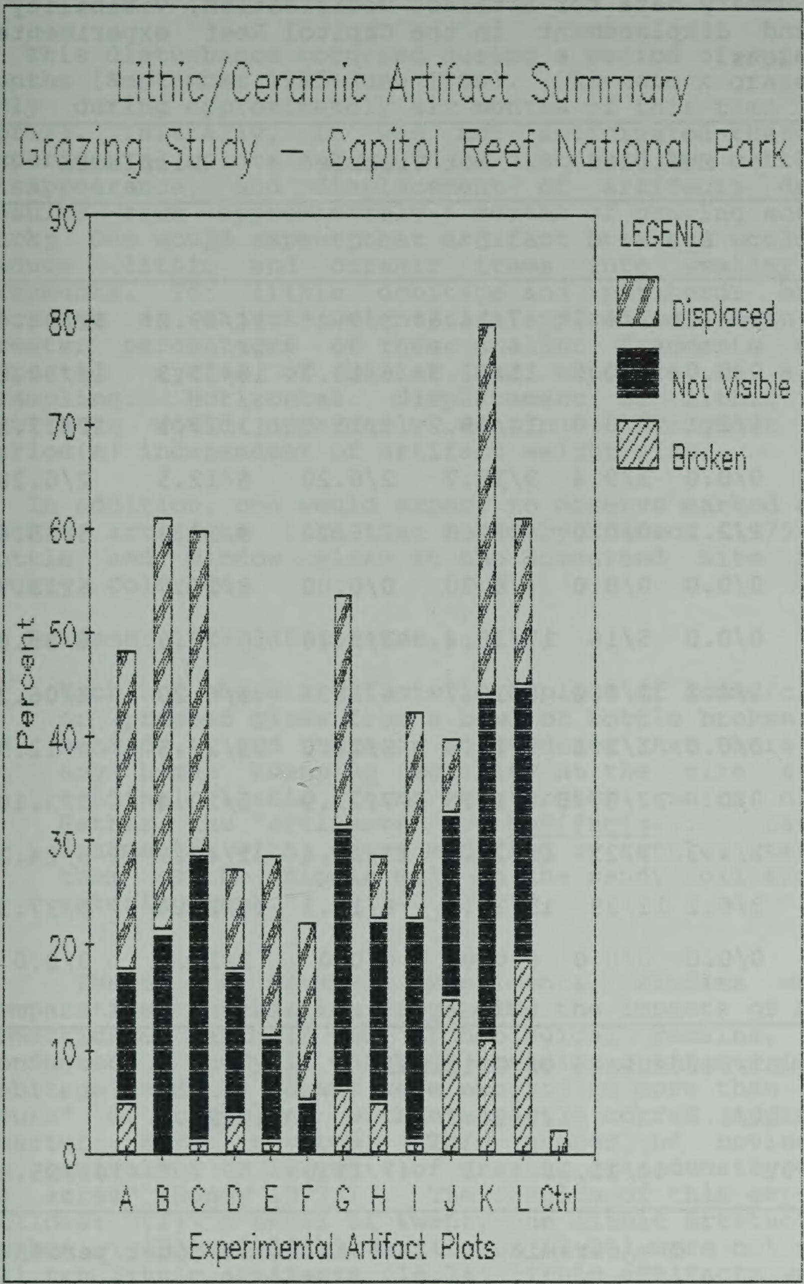

Figure 15. Lithic/ceramic artifact summary of experimental plots.

Table 5. Summary data for artifact modification, visibility and displacement in the Capitol Reef experimental plots.

Plot	Total		Modified		Not Visible		Displaced	
	L	C	L	C	L	C	L	C
A	48	32	2/4.2*	2/6.2*	7/14.6*	3/9.4*	14/29.2*	11/34.4*
B	48	32	0/0.0	0/0.0	11/22.9	6/18.7	16/33.3	16/50.0
C	48	32	1/2.1	0/0.0	14/29.2	8/25.0	13/27.1	12/37.5
D	48	32	0/0.0	3/9.4	9/18.7	2/6.20	6/12.5	2/6.20
E	48	32	1/2.1	0/0.0	6/12.5	2/6.20	9/18.7	5/15.6
F	48	32	0/0.0	0/0.0	4/8.30	0/0.00	8/16.7	6/18.7
G	48	32	0/0.0	5/16	17/35.4	3/9.40	10/20.8	8/25.0
H	48	32	2/4.2	2/6.2	8/16.7	6/18.7	3/6.20	2/06.2
I	49	31	0/0.0	1/3.1	8/16.3	9/29.0	12/24.5	4/12.9
J	48	32	0/0.0	12/37.5	7/14.6	7/21.9	5/10.4	1/3.10
K	47	33	2/4.3	7/21	13/27.6	13/39.4	21/44.7	8/24.2
L	49	31	3/6.1	12/39	15/30.1	6/19.3	10/20.4	3/37.5
Ctrl	12	8	0/0.0	0/0.0	0/0.0	0/0.0	2/16.7	0/0.0

Totals (Count/Percentage of Original)

	Total	Modified	Not Visible	Displaced
L	589/60	11/1.9	119/20.2	129/21.9
C	391/40	44/11.25	43/11.0	101/25.8

L = lithics C = ceramics * Artifact count/percent

This disturbance occurred during a period of approximately ten months (September 1985-June 1986). Livestock grazed in the Park only during approximately six months of this time (November to April). Initially, it was not anticipated that all of the experimental plots A-L would be disturbed by cattle. Breakage, disappearance, and displacement of artifacts described here results from approximately 6 months of grazing activity in the Park. One would expect that artifact breakage would continue to reduce lithic and ceramic items into smaller and smaller fragments. For lithic debitage and potsherds breakage would decrease as object weight/size approached a mean of 2 grams. Greater percentages of these smaller fragments would undergo repeated cycles of burial and exposure as a function of trampling. Horizontal displacement of lithic and ceramic artifacts would apparently continue throughout the grazing period(s) independent of artifact weight/size.

In addition, one would expect to observe marked edge damage on lithic artifacts like that noted by Knudson (1979) on historic bottle and window glass at the Homestead Site in Washington County, Colorado.

Knudson (1979:280) states,

> Each of these artifacts is a piece of commercial pane or pressed glass from a bowl or bottle broken or left behind..., and there is no evidence that there has been any human knapping activity at the site since the original lithic forms were broken and/or discarded. Rather, the "artifacts" are <u>bovifacts</u>... natural fragments with edges modified by cattle stepping on them as the animals mill in the sandy soil around the watering tank.

There are several experimental studies which provide comparative information regarding the impacts of both wild and domesticated animals on archeological remains. Roney (1977) conducted a study in which 60 obsidian artifacts (50 pieces of debitage and 10 cores) were exposed to more than 1311 "bovine hours" of trampling within a cattle corral approximately one quarter acre in area. This number of bovine hours is "...equivalent to 12 years of grazing at a density of one cow per 20 acres" (Roney 1977:2). The results of this experiment are as follows: (1) a total of twenty-one lithic artifacts (35%) were broken ; (2) two lithic artifacts (3.3%) were not visible ; and, (3) ten lithic artifacts (16.7%) lithic artifacts were displaced.

The results of the Capitol Reef experimental study differ markedly from Roney's findings (cf. Table 6). A chi square test using the Capitol Reef observations and lithic sample size (589) versus expected frequencies based on Roney's (1977) percentages (i.e., broken, 35%; not visible, 3.3%, displaced, 16.7%) reflects

this marked disparity. This difference is most probably due to greater intensity of livestock activity (i. e., 12 years of grazing at 1 AU/20 acres) reflected by Roney's study.

Another study of the impact of feral sheep on archeological resources was conducted by Van Vuren (1982) on Santa Cruz Island, California. Van Vuren (1982) established three experimental plots measuring 1 x 1 meter. He then placed 8 chert flakes along the plot borders one at each corner and one at each lateral midpoint. A total of 48 flakes were placed in high sheep density areas and 16 in low sheep density areas. After a period of six months, he found that 67 percent of the flakes in the high density sheep area were no longer visible and 33 percent had been displaced. Six percent of the flakes placed in the low sheep density area were not visible and 6 percent had been displaced. In both instances, the results of this study concerning feral sheep and archeological materials exceed those observed for Capitol Reef livestock (cattle).

Table 6. Comparison of the livestock impacts on archeological materials in Capitol Reef and Nevada Bureau of Land Management (Roney 1977) studies.

Variables	Capitol Reef		Nevada BLM
	Observed	Expected	Observed
Breakage	11(1.87%)	206(35.0%)	21(35%)
Not visible	119(20.2%)	19(3.3%)	2(3.3%)
Displaced	129(21.9%)	98(16.7%)	10(16.7%)
Total lithic artifacts	589		60

Chi square = 720.72
df = 2
p < 0.001 (two-tailed test)

The results of the present study suggest several considerations for archeological studies in the Southwest and elsewhere. First, ceramic remains or potsherds appear to undergo more severe adverse impacts due to livestock trampling than lithic remains, i.e., chipped stone tools and debitage. Traditionally, archeologists have relied primarily on prehistoric pottery for assigning dates and cultural affiliation to sites.

In 1924, pioneer Southwest archeologist A. V. Kidder (1962:161) summarized traditionalists' assumptions about the significance of prehistoric ceramics and stated,

> Pottery has so far provided the most useful material for such studies [chronological], as it is abundant at all sites except the very earliest, is readily classifiable, and is a highly sensitive register of cultural change.

S. Plog (1980:1) also points out that,

> In the American Southwest, for example, Martin and Plog (1973:252) have noted that within the ceramic wares defined by Colton (1955), 75 percent of the distinctions between the pottery types of different time periods are based on differences in stylistic attributes such as design elements or design layouts.

For example, S. Plog (1980:107) describes prehistoric design variation for the Mogollon area (eastern-central Arizona and west-central New Mexico) between A.D. 1000-1300. The shift from Wingate design style (A.D. 1000-1200) to Tularosa design style (A.D. 1100-1300) involves increased similarity of solid and hatched forms and closer spacing. Such a prehistoric design shift would, "... increase the probability that both hatched and solid forms would appear on a sherd of given size" (S. Plog 1980:107). Lack of opposed solid and hatched forms on the other hand on the Puerco style ceramics decreases the chances for observing both forms on a given potsherd.

This observed trend in prehistoric ceramics in the Southwest has significant, broad implications given the results of this experimental study in Capitol Reef National Park. Archeologists might experience greater difficulties in recognizing meaningful stylistic variation in prehistoric ceramics in regions where livestock grazing and associated trampling has occurred. Such difficulty in ceramic classification would, in this case, be a function of ceramic breakage and sherd size. This pertains primarily to discussions of surface artifact scatters. However, trampling can also adversely affect buried archeological materials and midden deposits containing ceramics.

Furthermore, the results of this study suggest that archeologists must consider the adverse impacts of livestock on lithic artifacts. A number of flakes were broken by livestock

trampling. Debitage breakage is significant with respect to lithic analyses designed to delineate functional site types or other forms of site taxonomies.

For example, Sullivan and Rosen (1985) utilize hierarchical cluster analysis in order to define four technological groupings of prehistoric debitage from archeological sites in east-central Arizona. Two of these archeological assemblages groups (Group I and II) are defined statistically on the basis of differential percentages of cores, complete flakes, and incomplete flakes/flake fragments. The investigators (1985:763) state,

> It is unlikely that nontechnical factors, such as trampling and natural processes, could have influenced these patterns substantially. First, the depositional environments of those sites where broken flakes and flake fragments dominate debitage assemblages are all characterized by extensive mantles of sand ....Therefore, chipped stone artifacts, especially debitage, would have been depressed into these sediments without breaking if they had been trampled .... Second, the most intensively occupied sites ... have the highest proportions of complete flakes and debris while the less intensively occupied Archaic sites have the highest proportions of broken flakes and flake fragments.... This is precisely the opposite of what one would expect if trampling and "settlement traffic" were contributing to artifact breakage.

Although these archeologists have ruled out human trampling, it is not clear if wild game and livestock trampling is included. However, if livestock grazing has occurred in this particular area of Arizona or in other study areas, the implications for archeological interpretations could be quite significant. This form of archeological site disturbance can no longer be ignored - particularly in the rangeland areas of the Southwest.

Management Considerations

It is difficult to generate meaningful comparisons using extant livestock, wildlife, and/or human trampling experiments. Several modifications and additions might be made with regard to this experimental study in Capitol Reef National Park. These changes include: (1) continued, systematic monitoring of existing experimental plots; (2) establishment of several additional control plots; (3) establishment of several additional experimental plots containing faunal remains; and, (4) increased emphasis on monitoring changes in site structure i.e., reorganization of the spatial arrangements of artifactual remains. A total of thirty-seven 1 x 1 meter grid units have been left in place within the Park boundaries. Three original grid units from each of the 12 experimental plots can continue to provide long term information regarding artifact breakage,

visibility, and displacement. Future examination of these plots should focus on long-term breakage patterns which can be attributable to livestock trampling. Several additional control plots could be established in order to monitor impact by wildlife and physical processes. Addition of faunal materials to our artifact inventory would provide extremely valuable information regarding natural processes which modify prehistoric food remains. Such impacts have not been systematically investigated in the Southwest.

There are two points that need to be emphasized here. First, as mentioned previously, we established one control plot in which livestock trampling did not occur. Initially, we were concerned that few, if any, of the twelve experimental plots would be impacted by livestock. The extent of these impacts suggest that livestock mobility within the Park is considerably greater than expected. This degree of livestock mobility is attributable to the scarcity of drinking water and the low primary productivity of arid lands within the Park. Forage availability is further reduced during the winter season in this cold desert biome. One might suggest that such increased mobility of livestock in arid lands exacerbates the problems posed by grazing in Capitol Reef National Park.

Secondly, examination of previously recorded archeological sites in the Muley Twist Canyon (e. g., Lister 1959) in the southern portion of the Park revealed previously unreported vandalism in a rockshelter (42GA456). This illegal excavation destroyed a portion of the archeological deposits which contain chipped stone tools, manos and metates, potsherds, and a sandstone slab feature e. g., hearth or cist. This destruction took place since Lister's visit in 1958. Also, examination of another rockshelter (42GA458) revealed that a small sandstone slab structure had been disturbed since 1958. This archeological disturbance is most probably due to campers and/or domestic livestock. Perhaps the closure of the Halls Creek jeep trail near this concentration of archeological sites will prevent further illegal activity at these rockshelter sites.

Field observations at these Muley Twist sites suggested a previously unanticipated form of livestock impact on archeological resources in the Park. Rockshelters and caves used by livestock during inclement weather or for shade will contain dung deposits. Once such dung deposits become very dry or desiccate, they can easily be set fire by backpacker/camper fires. Sites visited during our fieldwork which contain potentially combustible dung deposits are: 42GA651, 42GA456 and 42WN1652. Such shelter/cave fires have occurred in South African cave sites containing sheep dung deposits (Klein 1980) and the paleontological cave site in the western portion of the Grand Canyon which contained extinct sloth dung deposits (Agenbroad, personal communication). Precautions should be taken in Capitol Reef National Park to prevent similar destruction of cultural resources associated with "livestock shelters." This threat is particularly significant if sheltered archeological deposits

contain perishable materials such as basketry, wooden tools, plant remains, and desiccated human remains. Such artifactual/ecofactual material is characteristic of sites within the Park. For this reasons, perhaps all camping activities by backpackers as well as cattle ranchers should be prohibited in overhangs, alcoves, and caves within the Park.

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APPENDIX I

ARTIFACT POSITION AND CONDITION

APPENDIX 1
ARTIFACT POSITION AND CONDITION

PLOT A DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: NOT COLLECTED						
A37	OB FLAKE	3	NW-2	S	0.5	
A22	OB SHATTER	10	DOQ	S	3.4	
A41	OB SHATTER	13	IN SITU	S	0.3	
A34	CHAL FLAKE	18	NW-4	S	2.2	
A77	CER	21	DIC	S	2.2	
A64	CER	23	NW-22	S	10.5	
A90	CER	27	DIC	S	1.2	
A83	CER	28	IN SITU	S	3.2	
A24	OB BIFACE	36	DOQ	S	3.8	
A33	CH FLAKE	40	NW-57	S	2.8	
A9	OB FLAKE	42	NW-57/58	S	10.0	
A78	CER	46	DIC	S	6.5	
A31	OB FLAKE	71	DIC	S	1.5	
A5	OB FLAKE	74	IN SITU	S	39.1	
A47	OB FLAKE	87	?	?	0.7	NOT VISIBLE
A52	OB SHATTER	89	DIC	S	1.0	PARTIALLY BURIED
A17	OB FLAKE	92	IN SITU	S	4.5	
A71	CER	95	DOQ	S	11.7	
A87	CER	97	?	?	0.1	NOT VISIBLE
A61	CER	98	DIC	S	15.9	
NE QUAD: NOT COLLECTED						
A75	CER	8	DOQ	S	2.0	
A95	CER	9	DIC	S	0.1	
A45	OB FLAKE	10	DIC	S	0.8	
A88	CER	18	DIC	S	0.5	
A32	CH SHATTER	19	DIC	S	4.7	
A57	OB FLAKE	27	DIC	S	0.3	
A13	CH SHATTER	28	DOC	S	6.8	
A74	CER	30	IN SITU	S	3.0	
A26	OB FLAKE	32	IN SITU	S	1.8	
A67	CER	49	IN SITU	S	11.3	
A58	OB FLAKE	51	DIC	S	0.8	
A46	OB FLAKE	52	IN SITU	S	0.2	
A92	CER	58	NE-59	S	1.7	
A76	CER	68	DIC	S	3.2	
A3	CH FLAKE	70	DIC	S	24.5	
A73	CER	77	NE-77/84	S	2.9	
A68	CER	79	IN SITU	S	14.1	
A14	CH FLAKE	88	NE-73	S	4.7	
A7	OB FLAKE	94	?	?	11.3	NOT VISIBLE
A91	CER	100	?	?	0.8	NOT VISIBLE

ARTIFACT POSITION AND CONDITION

PLOT A DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: NOT COLLECTED						
A19	OB SHATTER	4	DOC	S	10.2	
A30	OB FLAKE	8	DOC	S	4.7	
A55	OB FLAKE	13	DOC	B	0.2	
A27	OB FLAKE	14	DOC	S	3.5	
A2	OB FLAKE	16	IN SITU	S	37.3	
A16	OB FLAKE	20	?	?	5.2	NOT VISIBLE
A20	CH SHATTER	25	SW-17	S	4.8	
A62	CER	27	OCB	S	12.0	
A93	CER	28	IN SITU	S	0.7	
A10	OB SHATTER	31	DOC	S	15.9	
A56	CHAL FLAKE	33	?	?	0.6	NOT VISIBLE
A40	CH FLAKE	42	DOC	S	0.3	
A44	OB FLAKE	43	?	?	0.2	NOT VISIBLE
A21	OB FLAKE	57	OCB	S	4.2	
A25	CH FLAKE	72	IN SITU	S	8.2	
A96	CER	73	?	?	0.1	NOT VISIBLE
A97	CER	78	IN SITU	S	0.1	
A94	CER	82	DOC	S	0.8	
A89	CER	98	IN SITU	S	1.1	
A42	OB FLAKE	99	DIC	B	0.1	
SE QUAD: COLLECTED						
A38	CH FLAKE	9	?	?	0.3	NOT VISIBLE
A43	OB FLAKE	10	?	?	0.3	NOT VISIBLE
A4	OB FLAKE	31	CELL	S	12.9	
A98	CER	33	CELL	S	0.2	
A23	CH FLAKE	34	SE-27	E'	32>8	
A63	CER	46	SE-35	S	20.8	
A69	CER	49	CELL	B/ED	11.4/11.4	3 FRAGS
A15	OB FLAKE	50	SE-31	S	2.3	
A80	CER	52	SE-49	S	3.6	
A51	OB FLAKE	63	CELL	S	0.2	
A18	OB FLAKE	67	CELL	S	11.3	
A53	OB FLAKE	70	CELL	S	0.1	
A1	OB FLAKE	73	CELL	S	27.1	
A82	CER	76	CELL	S	2.6	
A8	OB FLAKE	84	CELL	S	6.6	
A65	CER	86	CELL	S	13.2	
A54	OB SHATTER	92	CELL	S	0.7	
A70	CER	98	SE-100	S	12.5	
A81	CER	100	SE-81	ED	3.1/3.1	

ARTIFACT POSITION AND CONDITION

PLOT B DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: COLLECTED						
B178	CER	1	CELL	S	3.6	
B138	OB FLAKE	2	CELL	S	0.9	
B143	OB FLAKE	3	?	?	0.7	NOT VISIBLE
B106	OB FLAKE	4	NW-2/3/18/19	S	115.1	
B184	CER	7	NW-6	S	1.8	
B107	OB FLAKE	9	NW-8/9	S	10.1	
B185	CER	13	NW-14	S	1.8	
B164	CER	15	NW-5/6	S	10.2	
B132	OB FLAKE	19	?	?	3.4	NOT VISIBLE
B108	OB FLAKE	38	NW-41/60	S	75.2	
B139	FLAKE	44	?	?	0.6	
B121	OB FLAKE	49	NW-32/49	S	4.0	
B119	OB FLAKE	72	NW-73/68	S	6.8	
B163	CER	75	NW-66/75	S	24.3	
B131	OB SHATTER	77	?	?	5.9	NOT VISIBLE
B158	CHAL FLAKE	79	?	?	0.4	NOT VISIBLE
B176	CER	81	CELL	S	4.2	
B142	CHAL FLAKE	83	?	?	0.4	NOT VISIBLE
B117	OB FLAKE	93	?	?	3.1	NOT VISIBLE
B141	OB FLAKE	100	?	?	<0.1	NOT VISIBLE
NE QUAD: NOT COLLECTED						
B133	OB FLAKE	1	NW-10	S	2.2	
B189	CER	6	?	?	1.1	NOT VISIBLE
B177	CER	7	?	?	3.4	NOT VISIBLE
B154	OB SHATTER	8	DOQ	S	0.5	
B122	OB SHATTER	13	DIC	S	3.6	
B110	OB FLAKE	20	NW-11	S	13.0	
B168	CER	21	NW-30	S	10.4	
B129	OB FLAKE	28	DOQ	S	2.9	
B144	OB FLAKE	34	?	?	1.1	NOT VISIBLE
B194	CER	46	NE-45	S	<0.1	
B175	CER	48	NE-34	S	5.2	
B130	OB FLAKE	51	NE-52	S	4.8	
B171	CER	54	NE-46	S	22.9	
B193	CER	74	NE-75	S	0.6	
B170	CER	76	NE-78	S	16.6	
B101	OB FLAKES	77	OCB	S	15.1	
B115	OB FLAKE	82	DIC	S	2.3	
B118	CH FLAKE	83	IN SITU	S	7.9	
B174	CER	96	NE-66	S	5.5	
B157	OB FLAKE	98	DIC	S	<0.1	

ARTIFACT POSITION AND CONDITION

PLOT B DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: NOT COLLECTED						
B182	CER	15	SW-5	S	1.6	
B152	OB SHATTER	16	IN SITU	S	0.6	
B187	CER	21	DOQ	S	1.3	
B113	CH FLAKE	26	IN SITU	S	0.9	
B140	OB FLAKE	27	?	?	0.1	NOT VISIBLE
B151	CH FLAKE	33	SW-28	S	0.2	PARTIALLY BURIED
B153	CHAL FLAKE	34	SW-35	S	0.5	
B116	OB FLAKE	37	IN SITU	S	2.4	
B195	CER	39	?	?	<0.1	NOT VISIBLE
B128	OB SHATTER	54	DOQ	S	3.3	
B183	CER	58	DIC	S	1.5	
B156	CH FLAKE	62	SW-59	S	0.2	
B188	CER	64	IN SITU	S	1.1	
B173	CER	72	SW-69	S	5.8	
B145	OB FLAKE	73	IN SITU	S	0.8	
B149	OB FLAKE	75	DIC	S	0.5	
B103	OB FLAKE	79	?	?	7.7	NOT VISIBLE
B114	OB FLAKE	83	SW-78	S	0.9	
B191	CER	88	SW-73	S	0.4	
B181	CER	97	?	?	2.8	NOT VISIBLE
SE QUAD: NOT COLLECTED						
B196	CER	2	DIC	S	0.5	
B120	OB FLAKE	12	?	?	1.8	NOT VISIBLE
B137	OB FLAKE	15	DIC	S	0.6	
B126	OB FLAKE	16	SE-17	S	0.9	
B190	CER	19	DIC	S	0.7	
B150	OB SHATTER	23	DIC	S	0.9	
B134	OB FLAKE	30	IN SITU	S	1.1	
B161	CER	31	DOQ	S	11.6	
B192	CER	35	DIC	S	<0.1	
B197	CER	37	?	?	0.2	NOT VISIBLE
B155	CH FLAKE	41	DIC	S	<0.1	
B165	CER	64	DIC	S	23.0	
B127	OB FLAKE	65	SE-56	S	1.1	
B109	OB FLAKE	72	DIC	S	6.8	
B102	OB FLAKE	73	DIC	S	34.8	
B169	CER	82	OCB	S	6.4	
B198	CER	84	?	?	<0.1	NOT VISIBLE
B125	OB FLAKE	87	IN SITU	S	1.9	
B146	OB FLAKE	89	DIC	S	0.2	
B162	CER	92	OCB	S	10.5	

ARTIFACT POSITION AND CONDITION

PLOT C DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: COLLECTED						
C225	OB SHATTER	12	NW-9/10/11	S	2.2	
C210	CH FLAKE	13	NW-12/13	S	14.2	
C270	CER	17	?	?	11.1	NOT VISIBLE
C276	CER	23	NW-18/19	S	1.9	
C220	OB FLAKE	24	NW-17/18	S	1.4	
C204	OB FLAKE	25	CELL	E	6.0/6.0	
C243	OB FLAKE	26	CELL	S	<0.1	
C283	CER	28	NW-13	S	3.0	
C222	OB FLAKE	30	NW-12	S	3.3	
C219	OB FLAKE	39	NW-22	S	1.5	
C247	CH FLAKE	40	?	?	0.1	NOT VISIBLE
C221	OB SHATTER	44	NW-43/44	S	3.5	
C295	CER	68	NW-53	S	0.5	
C298	CER	69	?	?	0.7	NOT VISIBLE
C229	OB FLAKE	71	NW-70/71	S	4.5	
C296	CER	73	NW-74	S	<0.1	
C278	CER	76	NW-64/65/76/77	S	2.4	
C254	FLAKE	82	?	?	0.2	NOT VISIBLE
C264	CER	86	NW-85/86	S	11.7	
C218	OB FLAKE	91	?	?	0.9	NOT VISIBLE
NE QUAD: NOT COLLECTED						
C226	OB FLAKE	4	DIC	S	0.9	
C271	CER	7	DIC	S	2.9	
C297	CER	15	DOQ	S	<0.1	
C203	OB FLAKE	21	DIC	S	5.2	
C242	OB SHATTER	35	NE-26	S	1.1	
C248	OB FLAKE	41	DIC	S	0.3	
C255	OB SHATTER	48	DIC	S	0.8	
C257	OB SHATTER	55	DIC	S	0.3	
C284	CER	57	?	?	3.8	NOT VISIBLE
C265	CER	58	IN SITU	S	18.9	
C258	CHAL FLAKE	65	?	?	1.1	NOT VISIBLE
C256	OB FLAKE	66	DIC	S	0.2	
C266	CER	70	NE-51	S	9.1	
C241	OB FLAKE	71	?	?	<0.1	NOT VISIBLE
C293	CER	72	?	?	0.7	NOT VISIBLE
C228	OB FLAKE	75	DIC	S	1.4	
C209	OB FLAKE	83	?	?	12.3	NOT VISIBLE
C227	OB FLAKE	86	DIC	S	4.8	
C294	CER	88	NW-73/74/87/88	S	0.5	
C277	CER	92	?	?	4.1	NOT VISIBLE

ARTIFACT POSITION AND CONDITION

PLOT C DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: NOT COLLECTED						
C230	OB FLAKE	1	DIC	S	1.8	
C290	CER	5	?	?	0.1	NOT VISIBLE
C291	CER	8	?	?	0.1	NOT VISIBLE
C292	CER	12	IN SITU	S	0.4	PARTIALLY BURIED
C238	OB FLAKE	17	IN SITU	S	0.3	
C268	CER	23	IN SITU	S	15.2	
C285	CER	28	?	?	1.3	NOT VISIBLE
C237	CHAL FLAKE	30	?	?	0.2	NOT VISIBLE
C269	CER	38	IN SITU	S	23.7	
C208	OB FLAKE	46	DIC	S	4.8	
C261	CER	63	SW-58/59/62/63	S	19.3	
C201	OB SHATTER	64	IN SITU	S	9.3	
C262	CER	67	DIC	S	10.3	
C214	OB FLAKE	77	SW-64	B	4.7	2 FRAGS
C239	CH SHATTER	81	?	?	0.6	NOT VISIBLE
C240	OB FLAKE	85	?	?	0.7	NOT VISIBLE
C215	OB FLAKE	86	IN SITU	S	3.0	
C263	CER	90	DIC	S	9.1	
C244	OB FLAKE	91	IN SITU	S	0.6	
C273	CER	96	OCB	S	7.0	PARTIALLY BURIED
SE QUAD: NOT COLLECTED						
C275	CER	2	DIC	S	3.6	
C286	CER	4	DIC	S	5.2	
C251	OB FLAKE	6	DIC	S	<0.1	
C231	OB FLAKE	8	IN SITU	S	0.9	
C207	OB FLAKE	9	?	?	12.5	NOT VISIBLE
C288	CER	17	DIC	S	0.9	
C249	OB FLAKE	19	SE-2	S	0.2	
C216	OB FLAKE	28	?	?	1.8	NOT VISIBLE
C232	OB FLAKE	43	IN SITU	S	1.6	
C252	CH FLAKE	50	SE-31	S	1.3	
C287	CER	51	SE-29	S	1.5	
C250	OB FLAKE	55	?	?	0.2	NOT VISIBLE
C289	CER	57	DIC	S	1.6	
C233	OB FLAKE	63	?	?	1.1	NOT VISIBLE
C253	CH FLAKE	67	?	?	0.5	NOT VISIBLE
C274	CER	71	SE-91	S	5.2	
C202	OB FLAKE	75	IN SITU	S	6.5	
C217	OB FLAKE	88	SE-73	S	2.7	
C234	OB FLAKE	94	IN SITU	S	1.4	
C213	OB FLAKE	95	SE-86	S	0.7	

ARTIFACT POSITION AND CONDITION

PLOT D DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: NOT COLLECTED						
D327	OB FLAKE	2	OCB	S	1.6	ON QUAD BORDER
D373	CER	5	DIC	S	4.5	
D356	FLAKE	19	IN SITU	S	0.3	
D378	CER	30	DOQ	S	2.7	
D340	OB SHATTER	35	NW-15	S	0.8	
D382	CER	38	?	?	1.3	NOT VISIBLE
D346	OB FLAKE	45	?	?	0.1	NOT VISIBLE
D381	CER	53	DIC	B	1.1	2 FRAGS
D392	CER	57	NW-58	S	1.0	PARTIALLY BURIED, NEW POS VERT
D304	OB CORE	63	IN SITU	S	26.6	
D349	OB FLAKE	64	NW-57	S	0.3	
D368	CER	69	DIC	S	11.4	PARTIALLY BURIED
D367	CER	75	IN SITU	S	8.8	
D315	OB FLAKE	83	OCB	S	1.0	
D398	CER	87	IN SITU	S	0.9	
D351	FLAKE	90	?	?	0.5	NOT VISIBLE
D313	OB FLAKE	92	OCB	S	4.8	
D316	OB FLAKE	95	NW-86	S	1.4	
D342	CH FLAKE	97	OCB	S	1.0	
D341	OB FLAKE	99	NW-82	S	0.2	
NE QUAD: NOT COLLECTED						
D362	CER	7	OCB	S	12.5	ON QUAD BORDER
D318	OB FLAKE	10	OCB	S	4.0	ON QUAD BORDER
D391	CER	12	OCB	S	0.7	
D317	OB FLAKE	15	IN SITU	S	1.0	
D364	CER	17	OCB	S	9.1	
D329	OB FLAKE	18	DIC	S	0.9	
D374	CER	33	OCB	S	4.1	
D319	OB SHATTER	34	IN SITU	S	2.3	
D348	OB FLAKE	45	IN SITU	S	0.3	
D307	CHAL FLAKE	51	OCB	S	7.6	
D390	CER	64	DIC	B	1.6	2 FRAGS
D325	OB FLAKE	67	DIC	S	1.3	
D379	CER	69	OCB	S	2.5	
D314	OB SHATTER	75	?	S	2.3	NOT VISIBLE
D389	CER	78	DIC	S	0.8	
D361	CER	80	OCB	B	18.8	3 FRAGS
D330	OB SHATTER	89	DIC	S	2.2	
D320	FLAKE	94	?	S	1.5	NOT VISIBLE
D388	CER	97	?	S	0.3	NOT VISIBLE
D369	CER	99	IN SITU	S	17.1	

ARTIFACT POSITION AND CONDITION

PLOT D DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms orig/new)	Comments
SW QUAD: NOT COLLECTED						
D326	BIFACE	10	DIC	S	2.4	
D338	OB FLAKE	15	IN SITU	S	0.3	
D377	CER	18	IN SITU	S	2.8	
D324	OB FLAKE	21	IN SITU	S	4.2	
D392	CER	31	OCB	S	0.1	ON QUAD BORDER
D354	OB FLAKE	33	SW-34	S	0.2	
D339	OB FLAKE	39	IN SITU	S	0.3	
D352	OB FLAKE	41	OCB	S	0.8	ON QUAD BORDER
D394	CER	44	OCB	S	1.3	
D322	OB FLAKE	46	OCB	S	5.1	
D347	OB SHATTER	48	?	?	0.2	NOT VISIBLE
D353	CH FLAKE	54	?	?	0.4	NOT VISIBLE
D321	OB FLAKE	68	SW-67	S	1.1	
D331	OB FLAKE	72	SW-73	S	2.3	
D303	OB SHATTER	76	IN SITU	S	20.0	
D387	CER	77	DIC	S	0.3	PARTIALLY BURIED
D308	OB SHATTER	82	?	?	37.1	NOT VISIBLE
D323	OB FLAKE	84	IN SITU	S	2.9	
D370	CER	96	OCB	S	13.3	
D363	CER	97	OCB	S	12.1	
SE QUAD: COLLECTED						
D343	OB FLAKE	61	CELL	S	0.4	
D302	OB FLAKE	16	CELL	S	8.6	
D376	CER	30	CELL	S	2.2	
D337	OB FLAKE	35	CELL	S	0.2	
D355	OB FLAKE	36	CELL	S	0.2	
D350	OB FLAKE	37	CELL	S	0.6	
D332	OB FLAKE	44	?	?	3.1	NOT VISIBLE
D397	CER	47	CELL	S	0.2	
D380	CER	48	CELL	S	1.2	
D301	OB FLAKE	54	CELL	S	41.2	
D396	CER	57	CELL	S	0.2	
D365	CER	64	CELL	S	12.5	
D395	CER	68	CELL	S	0.9	
D328	OB FLAKE	71	?	?	1.1	NOT VISIBLE
D366	CER	75	SE-74/75	S	11.0	
D345	OB FLAKE	76	CELL	S	<0.1	
D344	OB FLAKE	88	CELL	S	0.4	
D375	CER	89	CELL	S	3.7	
D306	OB FLAKE	96	CELL	S	20.3	PARTIALLLY BURIED
D305	OB FLAKE	98	CELL	S	11.3	

ARTIFACT POSITION AND CONDITION

PLOT E DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: NOT COLLECTED						
E412	OB FLAKE	3	OCB	S	36.6	ON QUAD BORDER
E426	OB FLAKE	7	OCB	S	4.1	
E458	OB FLAKE	8	?	?	1.1	NOT VISIBLE
E406	UNIFACE	14	OCB	S	25.1	
E432	OB FLAKE	31	NW-32	S	2.4	
E425	OB SHATTER	34	OCB	S	2.6	
E483	CER	35	IN SITU	S	1.5	
E484	CER	42	OCB	S	2.3	
E433	OB FLAKE	54	OCB	S	4.2	
E465	CER	56	OCB	S	7.6	
E464	CER	58	OCB	S	22.7	
E427	OB FLAKE	64	OCB	S	6.8	
E482	CER	67	OCB	S	2.6	
E417	OB FLAKE	72	DIC	S	2.1	
E435	OB FLAKE	74	NW-73	S	2.0	PARTIALLY BURIED
E438	CHAL FLAKE	80	NW-61	S	0.2	
E416	OB SHATTER	92	IN SITU	S	4.8	
E402	OB FLAKE	94	SW-14	S	38.8	
E409	OB FLAKE	98	?	?	6.0	NOT VISIBLE
E431	OB FLAKE	100	NW-81	S	5.5	
NE QUAD: COLLECTED						
E401	OB FLAKE	3	CELL	S	4.3	
E439	OB FLAKE	6	CELL	S	0.2	
E454	OB SHATTER	12	CELL	S	0.5	
E469	CER	13	NE-30	S	17.7	
E452	FLAKE	17	?	?	<0.1	NOT VISIBLE
E478	CER	21	CELL	S	1.4	
E473	CER	38	CELL	S	3.0	
E430	OB FLAKE	39	CELL	S	3.3	
E462	CER	48	CELL	S	10.1	
E408	OB UNIFACE	49	NE-31/50	S	13.5	
E488	CER	55	CELL	S	1.5	
E444	OB FLAKE	57	CELL	B	0.3/0.3	2 FRAGS
E467	CER	60	CELL	S	7.5	
E442	CH FLAKE	68	CELL	S	0.7	
E443	OB FLAKE	69	CELL	S	0.6	
E441	FLAKE	78	?	?	<0.1	NOT VISIBLE
E477	CER	82	CELL	S	2.1	
E418	OB FLAKE	89	CELL	S	0.8	
E419	OB FLAKE	90	CELL	S	2.8	
E410	OB FLAKE	99	CELL	S	16.4	

ARTIFACT POSITION AND CONDITION

PLOT E DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: NOT COLLECTED						
E457	OB FLAKE	1	IN SITU	S	0.3	
E490	CER	5	SW-40	S	1.2	
E451	CH FLAKE	7	?	?	0.1	NOT VISIBLE
E420	OB FLAKE	13	DIC	S	2.6	PARTIALLY BURIED
E463	CER	35	SW-5/6	S	21.7	
E455	OB SHATTER	39	OCB	S	1.1	
E450	OB FLAKE	48	?	?	0.8	NOT VISIBLE
E423	OB SHATTER	50	IN SITU	S	6.1	
E404	OB FLAKE	54	SW-45	S	33.2	
E499	CER	55	IN SITU	S	0.8	
E453	OB FLAKE	59	SW-60	S	<0.1	
E415	OB FLAKE	62	OCB	S	3.0	
E461	CER	64	DIC	S	5.5	
E474	CER	66	IN SITU	S	3.0	
E489	CER	71	?	?	1.5	NOT VISIBLE
E403	OB FLAKE	72	SW-52	S	16.4	
E493	CER	79	IN SITU	S	0.5	
E456	OB FLAKE	93	IN SITU	S	0.1	PARTIALLY BURIED
E497	CER	95	IN SITU	S	0.1	
E413	OB FLAKE	97	IN SITU	S	0.8	
SE QUAD: NOT COLLECTED						
E498	CER	7	SE-6/7	S	1.3	
E495	CER	9	IN SITU	S	1.1	
E421	OB FLAKE	21	DIC	S	1.6	
E422	OB FLAKE	22	DIC	S	2.2	
E470	CER	24	IN SITU	S	13.7	
E476	CER	26	IN SITU	S	5.7	
E481	CER	28	IN SITU	S	3.5	
E449	OB FLAKE	32	DIC	S	0.5	
E492	CER	45	DIC	S	0.7	
E491	CER	49	DIC	S	0.2	
E448	CH FLAKE	55	DIC	S	0.1	
E496	CER	64	DIC	S	0.8	
E440	CHAL FLAKE	67	DIC	S	0.8	
E468	CER	75	SE-66/75	S	8.4	
E414	OB FLAKE	79	DIC	S	6.9	
E407	OB BIFACE	82	SW-79/82	S	46.6	
E480	CER	83	DIC	S	1.2	
E437	OB FLAKE	90	DIC	S	0.3	
E487	CER	95	?	?	1.1	NOT VISIBLE
E475	CER	97	SE-96	S	1.5	

ARTIFACT POSITION AND CONDITION

PLOT F DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: NOT COLLECTED						
F567	CER	6	NW-26	S	14.4	
F553	OB FLAKE	8	DIC	S	0.6	
F589	CER	12	IN SITU	S	0.9	
F534	OB SHATTER	18	IN SITU	S	1.6	
F564	CER	19	IN SITU	S	9.9	
F549	OB FLAKE	26	DIC	S	0.2	
F546	OB FLAKE	33	DIC	S	0.1	
F545	OB SHATTER	34	DIC	S	1.1	
F507	OB FLAKE	45	IN SITU	S	14.6	
F561	CER	50	NW-29	S	22.4	
F529	OB CORE	51	OCB	S	23.1	PARTIALLY BURIED, NEW POS VERT
F576	CER	60	IN SITU	S	2.2	
F585	CER	65	IN SITU	S	2.3	
F552	OB FLAKE	68	OCB	S	0.6	
F551	CHAL FLAKE	87	DIC	S	0.1	
F525	OB FLAKE	91	DIC	S	2.4	
F577	CER	93	IN SITU	S	2.1	
F583	CER	95	DIC	S	1.6	
F510	OB FLAKE	96	OCB	S	15.0	
F584	CER	97	IN SITU	S	3.1	
NE QUAD: NOT COLLECTED						
F508	OB FLAKE	11	?	?	11.7	NOT VISIBLE
F550	OB FLAKE	16	DIC	S	0.2	
F570	CER	19	OCB	S	6.5	
F518	OB FLAKE	22	OCB	S	6.8	PARTIALLY BURIED
F532	OB SHATTER	32	OCB	S	1.4	
F587	CER	34	OCB	S	1.6	
F569	CER	39	OCB	S	8.2	
F526	OB FLAKE	40	OCB	S	3.5	
F511	OB FLAKE	46	IN SITU	S	14.6	
F568	CER	54	IN SITU	S	8.7	
F520	CH FLAKE	55	IN SITU	S	6.6	
F501	OB FLAKE	56	IN SITU	S	15.2	
F563	CER	63	IN SITU	S	12.9	
F528	OB FLAKE	66	IN SITU	S	1.3	
F541	OB FLAKE	70	OCB	S	<0.1	
F588	CER	82	NE-79	S	0.9	
F544	OB FLAKE	90	OCB	S	0.4	
F543	CH FLAKE	93	DIC	S	0.3	
F533	CH SHATTER	95	OCB	S	2.2	
F542	CH FLAKE	99	NE-82	S	0.2	

ARTIFACT POSITION AND CONDITION

PLOT F   DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: NOT COLLECTED						
F514	OB FLAKE	2	IN SITU	S	2.5	
F575	CER	3	IN SITU	S	2.7	
F596	CER	7	IN SITU	S	0.7	
F503	OB FLAKE	13	IN SITU	S	37.8	
F574	CER	18	IN SITU	S	1.8	
F530	FLAKE	22	IN SITU	S	0.5	
F573	CER	27	OCB	S	5.5	
F522	OB FLAKE	30	SW-11	S	4.6	
F537	OB FLAKE	31	DOQ	S	<0.1	
F580	CER	39	OCB	S	1.6	
F540	OB FLAKE	48	DIC	S	0.2	
F599	CER	55	OCB	S	1.1	
F539	OB FLAKE	68	?	?	0.2	NOT VISIBLE
F562	CER	78	OCB	S	17.4	
F581	CER	80	OCB	S	1.2	
F597	CER	86	OCB	S	0.6	
F515	OB FLAKE	88	DIC	S	4.0	
F598	CER	92	SW-93	S	0.1	
F556	OB FLAKE	95	SW-99/100	S	0.6	
F592	CER	98	DIC	S	0.2	
SE QUAD: COLLECTED						
F527	FLAKE	6	CELL	S	3.6	
F505	OB SHATTER	8	CELL	S	45.1	
F595	CER	13	CELL	S	0.8	
F521	OB FLAKE	16	SE-17	S	1.6	
F506	CH SHATTER	18	SE-23/24	S	38.1	
F516	CH SHATTER	23	CELL	S	6.6	
F554	OB FLAKE	30	?	?	0.5	NOT VISIBLE
F538	CH SHATTER	36	SE-35	S	1.7	
F509	OB FLAKE	38	SE-38/39	S	7.2	
F594	CER	42	CELL	S	1.6	
F502	OB FLAKE	43	CELL	S	7.6	
F517	CH FLAKE	45	CELL	S	13.2	
F582	CER	47	SE-46/47	S	1.8	
F531	OB FLAKE	50	SE-49	S	1.6	
F590	CER	55	SE-54	S	0.5	
F591	CER	57	CELL	S	<0.1	
F557	OB FLAKE	63	CELL	S	<0.1	
F558	OB FLAKE	65	?	?	1.1	
F593	CER	68	CELL	S	1.0	
F555	OB FLAKE	85	CELL	S	0.3	

ARTIFACT POSITION AND CONDITION

PLOT G DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: NOT COLLECTED						
G648	CHAL SHATTER	2	?	?	0.8	NOT VISIBLE
G625	OB FLAKE	3	?	?	3.9	NOT VISIBLE
G621	CHAL FLAKE	11	DIC	S	1.0	
G619	CH FLAKE	17	NW-15/16	S	11.0	
G622	CH SHATTER	30	DIC	S	10.7	
G684	CER	31	DIC	S	2.1	
G607	OB BIFACE	37	DIC	S	34.8	
G608	CHAL FLAKE	39	NW-17	S	14.2	
G605	OB FLAKE	40	NW-3/4	S	15.4	
G644	OB FLAKE	41	?	?	0.2	NOT VISIBLE
G643	OB FLAKE	44	?	?	0.2	NOT VISIBLE
G627	CHAL SHATTER	48	DIC	S	3.3	
G646	OB FLAKE	52	DIC	S	1.8	
G645	CHAL FLAKE	56	NW-55	S	0.7	
G628	OB FLAKE	61	DOQ	S	4.1	
G620	OB FLAKE	72	DIC	S	2.7	
G651	OB FLAKE	78	DIC	S	<0.1	
G650	OB FLAKE	86	DIC	S	0.6	
G623	OB FLAKE	99	?	?	3.2	NOT VISIBLE
G626	CHAL FLAKE	100	OCB	S	2.1	ON QUAD BORDER
NE QUAD: COLLECTED						
G606	CH SHATTER	5	DOQ	S	23.4	
G666	CER	7	NE-6,7	ED	8.4/8.2	2 FRAGS LOCATED
G683	CER	21	CELL	S	4.7	
G697	CER	23	?	?	0.2	NOT VISIBLE
G696	CER	25	CELL	S	1.2	
G695	CER	26	CELL	B	0.7/0.7	2 FRAGS
G624	OB FLAKE	27	NE-14	S	3.8	
G669	CER	29	NE-28/29	S	9.0	
G676	CER	34	CELL	S	1.6	
G693	CER	35	NE-25/26/35/36	S	0.8	
G649	CHAL FLAKE	37	?	?	0.2	NOT VISIBLE
G667	CER	44	NE-43/44	S	6.5	
G694	CER	48	CELL	S	0.9	
G652	OB SHATTER	57	CELL	S	0.8	
G668	CER	67	CELL	ED	8.1/8.0	
G673	CER	68	CELL	S	2.3	
G674	CER	69	NE-52/69	S	3.4	
G647	OB FLAKE	71	CELL	S	0.1	
G692	CER	89	CELL	S	1.0	
G675	CER	93	CELL	S	1.0	

ARTIFACT POSITION AND CONDITION

PLOT G . DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: NOT COLLECTED						
G661	CBR	1	OCB	B	29.1	2 FRAGS
G604	OB BIFACE	3	IN SITU	S	15.9	
G641	CH FLAKE	13	?	?	<0.1	NOT VISIBLE
G640	CH FLAKE	25	SW-24	S	1.1	
G613	OB SHATTER	31	?	?	1.6	NOT VISIBLE
G642	FLAKE	40	?	?	0.5	NOT VISIBLE
G677	CBR	41	SW-40	S	5.6	
G653	CH FLAKE	45	?	?	<0.1	NOT VISIBLE
G615	OB FLAKE	48	?	?	3.1	NOT VISIBLE
G602	OB FLAKE	55	DIC	S	12.4	
G631	OB FLAKE	60	DIC	S	11.1	
G654	OB FLAKE	67	SW-75	S	0.3	
G632	OB FLAKE	71	?	?	0.5	NOT VISIBLE
G662	CBR	82	OCB	S	5.6	
G690	CBR	88	SW-72	B	0.3	2 FRAGS
G617	CH FLAKE	89	IN SITU	S	4.2	
G618	OB FLAKE	91	DIC	S	2.8	
G663	CBR	93	IN SITU	S	12.6	
G629	OB FLAKE	97	DIC	S	0.7	
G630	OB FLAKE	100	?	?	1.1	NOT VISIBLE
SE QUAD: NOT COLLECTED						
G616	OB FLAKE	3	OCB	S	1.6	
G689	CBR	4	?	?	1.0	NOT VISIBLE
G639	OB FLAKE	5	?	?	0.3	NOT VISIBLE
G680	CBR	12	IN SITU	S	1.6	PARTIALLY BURIED
G678	CBR	13	OCB	S	1.8	
G614	CH FLAKE	15	?	?	3.7	NOT VISIBLE
G603	OB SHATTER	21	OCB	S	25.2	
G664	CBR	31	OCB	S	12.5	
G682	CBR	34	IN SITU	S	2.9	
G681	CBR	35	IN SITU	S	1.2	PARTIALLY BURIED
G655	OB SHATTER	50	DOQ	S	0.7	
G601	OB FLAKE	57	OCB	S	91.4	
G679	CBR	64	SE-57	S	3.0	
G691	CBR	67	DIC	S	0.7	PARTIALLY BURIED
G637	OB FLAKE	70	DIC	S	0.9	
G688	CBR	78	?	?	0.6	NOT VISIBLE
G656	CHAL FLAKE	82	?	?	0.3	NOT VISIBLE
G638	OB FLAKE	85	?	?	0.5	NOT VISIBLE
G687	CBR	88	?	?	0.5	NOT VISIBLE
G665	CBR	89	OCB	S	9.7	

ARTIFACT POSITION AND CONDITION

PLOT H DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: COLLECTED						
H781	CER	5	CELL	S	1.0	
H708	CH FLAKE	13	CELL	S	23.6	
H707	OB FLAKE	17	CELL	S	13.7	
H771	CER	31	NW-29/32	S	10.1	
H703	OB BIFACE	42	CELL	S	16.9	
H782	CER	45	CELL	BD	3.0/2.9	
H702	OB FLAKE	47	CELL	S	5.0	
H749	OB SHATTER	50	NW-49	S	0.7	
H750	OB FLAKE	53	?	?	<0.1	NOT VISIBLE
H751	CH FLAKE	58	?	?	0.1	NOT VISIBLE
H718	OB FLAKE	69	CELL	B	3.7/3.7	2 FRAGS
H717	CH SHATTER	71	NW-89	S	8.5	
H753	CH FLAKE	76	NW-85	S	0.2	
H752	OB FLAKE	78	CELL	S	0.6	
H742	OB SHATTER	80	CELL	S	2.3	
H743	OB SHATTER	86	CELL	S	1.2	
H732	OB SHATTER	90	NW-91	S	3.3	
H733	OB SHATTER	92	CELL	S	3.1	
H731	CHAL FLAKE	96	CELL	S	1.0	
H730	CH FLAKE	97	CELL	S	1.6	
NE QUAD: NOT COLLECTED						
H784	CER	2	DIC	S	2.5	
H721	OB SHATTER	19	DIC	S	1.9	
H783	CER	23	DIC	S	1.1	
H791	CER	29	DIC	S	1.2	
H719	CH SHATTER	32	DIC	S	7.3	
H741	OB FLAKE	33	?	?	<0.1	NOT VISIBLE
H778	CER	40	IN SITU	S	5.1	
H711	CHAL FLAKE	45	IN SITU	S	15.5	
H789	CER	47	DIC	S	0.9	
H740	CH FLAKE	53	DOC	S	<0.1	
H790	CER	59	DOC	S	0.3	
H776	CER	66	IN SITU	S	1.4	
H728	CH SHATTER	67	IN SITU	S	1.5	
H739	OB FLAKE	73	IN SITU	S	0.1	
H768	CER	74	IN SITU	S	6.6	
H722	CH SHATTER	78	IN SITU	S	2.3	
H701	OB FLAKE	82	IN SITU	S	13.1	
H756	CH FLAKE	84	OCB	S	0.1	
H770	FLAKE	92	OCB	S	14.4	
H738	OB FLAKE	93	IN SITU	S	1.0	

ARTIFACT POSITION AND CONDITION

PLOT H DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: NOT COLLECTED						
H765	CER	4	OCB	S	14.3	ON QUAD BORDER
H734	OB SHATTER	5	DIC	S	1.9	
H795	CER	6	DIC	S	0.2	
H746	OB FLAKE	17	DOC	S	0.5	
H798	CER	21	?	S	0.9	NOT VISIBLE
H797	CER	39	DOC	S	1.0	
H714	CH SHATTER	42	DIC	S	1.7	
H713	OB FLAKE	47	DOC	S	7.1	
H796	CER	52	DIC	S	<0.1	
H715	CH FLAKE	55	OCB	S	9.5	
H766	CER	58	DIC	S	11.5	
H744	OB FLAKE	60	IN SITU	S	0.7	
H773	CER	63	OCB	S	3.0	
H774	CER	65	DIC	S	3.4	
H775	CER	71	DIC	S	1.2	
H745	OB FLAKE	78	IN SITU	S	2.2	
H762	CER	89	DIC	S	8.7	
H716	OB FLAKE	92	OCB	B	1.4	2 FRAGS
H793	CER	95	DIC	B	0.3	2 FRAGS
H794	CER	99	?	?	0.1	NOT VISIBLE
SE QUAD: NOT COLLECTED						
H737	FLAKE	9	DIC	S	1.6	
H777	CER	18	DOC	S	1.1	
H763	CER	19	OCB	S	23.2	
H710	CH SHATTER	20	OCB	S	53.8	
H769	CER	21	IN SITU	S	11.0	
H729	OB FLAKE	23	IN SITU	S	3.1	
H757	OB FLAKE	24	DOC	S	<0.1	
H755	CH FLAKE	33	DIC	S	0.5	
H727	OB FLAKE	46	OCB	S	2.2	
H788	CER	51	DOC	S	0.5	
H723	FLAKE	62	OCB	S	6.0	
H758	CHAL FLAKE	65	DIC	S	0.6	
H787	CER	69	OCB	S	1.4	
H754	CH FLAKE	71	DOC	S	0.5	
H764	CER	73	DIC	S	14.1	
H720	CHAL FLAKE	75	IN SITU	S	6.4	
H792	CER	89	DOC	S	0.6	
H706	OB FLAKE	91	OCB	S	63.6	
H725	OB SHATTER	93	DIC	S	2.1	
H761	CER	96	OCB	S	15.9	

ARTIFACT POSITION AND CONDITION

PLOT I DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: COLLECTED						
I895	CBR	2	CELL	S	0.8	
I890	CBR	5	CELL	S	1.6	
I837	CH FLAKE	6	?	?	0.1	NOT VISIBLE
I869	CBR	15	CELL	S	12.6	
I854	OB FLAKE	17	CELL	S	0.4	
I867	CBR	29	CELL	S	10.2	
I821	OB SHATTER	33	NW-69	S	11.5	
I838	OB FLAKE	36	?	?	0.4	NOT VISIBLE
I880	CBR	41	DOQ	S	2.5	
I881	CBR	51	CELL	S	2.8	
I850	CHAL FLAKE	54	NW-66	S	0.7	
I826	OB FLAKE	56	CELL	S	1.4	
I824	OB FLAKE	62	CELL	S	1.9	
I878	CBR	63	CELL	S	3.7	
I839	OB FLAKE	68	CELL	S	0.7	
I870	CBR	72	CELL	B	13.3/9.5	1 FRAG LOCATED
I825	OB BIFACE	79	CELL	S	4.5	
I865	CBR	82	CELL	S	12.7	
I832	OB SHATTER	92	CELL	S	12.5	
I882	CBR	100	CELL	S	1.3	
NE QUAD: NOT COLLECTED						
I851	CHAL FLAKE	1	NE-20	S	0.4	
I887	CBR	5	NE-25	S	1.6	
I843	OB SHATTER	10	NE-7	S	0.4	
I883	CBR	11	NE-12	S	1.4	
I836	OB FLAKE	13	NE-27/28	S	1.8	
I803	OB SHATTER	20	?	?	29.1	NOT VISIBLE
I873	CBR	27	IN SITU	S	2.4	
I849	OB FLAKE	37	NE-45	S	<0.1	
I805	OB FLAKE	39	IN SITU	S	5.9	
I888	CBR	43	IN SITU	S	0.3	
I804	OB FLAKE	49	IN SITU	S	29.7	
I891	CBR	51	NE-70	S	0.4	
I842	OB SHATTER	52	DIC	S	1.0	
I892	CBR	64	IN SITU	S	0.8	
I874	CBR	66	NE-54	S	3.3	
I844	OB FLAKE	68	?	?	<0.1	NOT VISIBLE
I877	CBR	71	NE-68	S	2.5	
I875	CBR	81	?	?	3.1	NOT VISIBLE
I802	OB FLAKE	83	DIC	S	16.6	
I894	CBR	90	DOQ	S	1.0	

ARTIFACT POSITION AND CONDITION

PLOT I DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: NOT COLLECTED						
I876	CBR	1	SW-20	S	4.4	
I816	OB FLAKE	7	DIC	S	1.4	PARTIALLY BURIED
I831	CH SHATTER	8	DIC	S	9.7	
I852	CH FLAKE	17	?	?	0.2	NOT VISIBLE
I808	OB FLAKE	22	IN SITU	S	21.0	
I861	CBR	23	DIC	S	8.1	
I893	CBR	28	SW-27	S	0.9	
I819	OB FLAKE	35	SW-24	S	4.3	
I822	OB FLAKE	36	IN SITU	S	3.4	
I823	CH SHATTER	43	IN SITU	S	2.6	
I815	OB FLAKE	44	?	?	2.2	NOT VISIBLE
I801	OB FLAKE	51	DIC	S	11.5	
I818	CH SHATTER	58	DIC	S	8.1	
I817	OB FLAKE	61	IN SITU	S	1.3	
I889	CBR	67	?	?	1.2	NOT VISIBLE
I814	OB FLAKE	70	?	?	0.8	NOT VISIBLE
I820	CH FLAKE	81	DOQ	S	2.0	
I853	CH FLAKE	82	IN SITU	S	1.2	
I841	OB FLAKE	85	?	?	0.1	NOT VISIBLE
I840	OB FLAKE	94	DIC	S	0.4	
SE QUAD: NOT COLLECTED						
I847	OB FLAKE	5	?	?	<0.1	
I813	OB SHATTER	10	DIC	S	1.7	
I864	CBR	12	?	?	10.7	NOT VISIBLE
I807	CH SHATTER	22	DIC	S	41.0	
I827	OB FLAKE	30	IN SITU	S	2.4	NEW POS VERT
I846	OB FLAKE	32	?	?	0.7	NOT VISIBLE
I806	OB FLAKE	48	DIC	S	21.0	
I848	OB FLAKE	52	?	?	<0.1	NOT VISIBLE
I863	CBR	53	DIC	S	10.8	
I828	CHAL FLAKE	54	DIC	S	4.0	
I869	CBR	57	IN SITU	S	0.3	
I830	OB FLAKE	63	DIC	S	1.4	
I866	CBR	68	DIC	S	6.1	
I897	CBR	72	?	?	<0.1	NOT VISIBLE
I829	OB FLAKE	80	SE-81	S	6.9	
I855	OB FLAKE	82	DIC	S	0.7	
I845	CH FLAKE	83	DIC	S	0.8	
I856	OB FLAKE	84	?	?	0.3	NOT VISIBLE
I868	CBR	95	DIC	S	9.4	
I862	CBR	98	DIC	S	8.6	

ARTIFACT POSITION AND CONDITION

PLOT J DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD:	NOT COLLECTED					
J908	OB CORE	3	IN SITU	S	35.4	
J975	CER	8	IN SITU	B	3.0	
J926	CHAL FLAKE	13	IN SITU	S	3.3	
J976	CER	15	DIC	S	5.2	
J909	OB FLAKE	16	IN SITU	S	10.3	
J988	CER	17	IN SITU	S	0.7	
J951	CHAL SHATTER	38	DIC	S	0.6	
J914	OB FLAKE	42	DIC	S	1.3	
J968	CER	44	OCB	B	4.7	2 FRAGS
J910	OB FLAKE	46	DOC	S	22.7	
J927	OB FLAKE	52	DIC	S	0.8	
J969	CER	56	IN SITU	S	11.7	
J949	OB SHATTER	58	IN SITU	S	0.6	
J973	CER	67	DIC	B	3.5	2 FRAGS
J913	OB FLAKE	68	DIC	S	2.2	
J974	CER	80	OCB	B	2.7	ON QUAD BORDER
J987	CER	85	DIC	S	0.5	
J925	OB FLAKE	88	DIC	S	1.2	
J928	OB FLAKE	92	DOQ	S	11.4	
J950	OB SHATTER	93	DIC	S	1.1	
NE QUAD:	COLLECTED					
J961	CER	15	CELL	S	12.1	
J904	OB SCRAPER	19	CELL	S	8.8	
J921	CH SHATTER	20	CELL	S	12.6	
J954	CHAL SHATTER	23	?	?	0.4	NOT VISIBLE
J991	CER	25	CELL	S	0.5	
J953	CH FLAKE	27	NE-13	S	0.3	
J978	CER	28	CELL	B	4.1/4.1	
J977	CER	40	CELL	B	3.2/3.2	
J962	CER	48	NE-48/49	B/ED/B	22.0/20.3	7 FRAGS LOCATED
J920	OB FLAKE	49	NE-30	S	4.1	
J990	CER	54	CELL	B	1.1/1.1	2 FRAGS
J919	OB UNIFACE	58	?	?	8.8	NOT VISIBLE
J979	CER	62	NE-62,79	B/ED	3.0/3.0	2 FRAGS
J952	OB FLAKE	75	NE-74/67	S	0.8	
J989	CER	76	NE-65	B	0.6/<0.1	1 FRAG LOCATED
J905	OB FLAKE	78	NE-87	S	13.4	
J933	CHAL FLAKE	80	CELL	S	3.0	
J934	OB SHATTER	82	CELL	S	4.4	
J932	OB FLAKE	90	CELL	S	1.6	
J907	OB FLAKE	94	CELL	S	8.5	

ARTIFACT POSITION AND CONDITION

PLOT J DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD:	NOT COLLECTED					
J945	OB FLAKE	6	DIC	S	0.4	
J967	CER	7	OCB	B	12.6	3 FRAGS
J937	OB FLAKE	17	DIC	S	0.4	NEW POS VERT
J918	OB FLAKE	18	DIC	S	1.2	
J983	CER	19	IN SITU	S	1.2	
J929	CH SHATTER	20	IN SITU	S	2.0	IN DUNGU
J940	CH FLAKE	31	DIC	S	0.7	
J941	CHAL FLAKE	38	?	?	<0.1	NOT VISIBLE
J939	OB FLAKE	39	?	?	1.8	NOT VISIBLE
J943	OB FLAKE	50	OCB	S	0.7	
J931	OB FLAKE	57	?	?	1.9	NOT VISIBLE
J942	OB FLAKE	64	DIC	S	1.7	
J916	OB FLAKE	66	IN SITU	S	0.7	
J903	OB FLAKE	68	DIC	S	8.8	
J917	OB SHATTER	72	OCB	S	7.6	
J984	CER	73	?	?	1.0	NOT VISIBLE
J930	OB FLAKE	76	IN SITU	S	1.7	
J938	OB FLAKE	78	IN SITU	S	0.3	
J946	OB SHATTER	82	IN SITU	S	1.0	
J944	OB SHATTER	85	DOC	S	1.3	
SE QUAD:	NOT COLLECTED					
J966	CER	2	DIC,DOC	B	9.4	3 FRAGS
J965	CER	4	IN SITU	S	9.8	
J980	CER	25	?	?	1.4	NOT VISIBLE
J956	CH FLAKE	26	IN SITU	S	0.2	
J995	CER	27	DIC	S	0.5	
J955	OB FLAKE	29	DIC	S	0.4	
J997	CER	30	DIC	S	0.6	
J963	CER	32	DOC	B	14.4	
J915	CH FLAKE	37	?	S	2.3	
J902	CH SHATTER	43	DIC	S	21.2	
J981	CER	51	DIC	S	2.5	
J994	CER	53	DOC	S	0.8	
J993	CER	56	DOC	S	0.4	
J964	CER	64	IN SITU	S	7.3	
J958	OB FLAKE	68	DOC	S	0.1	
J982	CER	73	IN SITU	S	1.8	
J996	CER	74	IN SITU	S	0.5	
J901	OB FLAKE	76	OCB	S	11.6	
J992	CER	80	DOC	S	1.0	
J957	CH FLAKE	92	DIC	S	0.8	

ARTIFACT POSITION AND CONDITION

PLOT K DISTURBANCE: Livestock/Wildlife

NW QUAD: NOT COLLECTED

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
D333	OB FLAKE	2	DOC	S	1.6	
G700	CER	5	?	?	0.8	NOT VISIBLE
G635	OB FLAKE	7	OCB	S	1.1	
J923	CH SHATTER	27	?	?	2.3	NOT VISIBLE
G611	OB FLAKE	31	OCB	S	7.8	
G610	OB BIFACE	40	DOC	S	14.4	
G685	CER	46	?	?	1.3	NOT VISIBLE
D334	OB FLAKE	55	?	?	2.8	NOT VISIBLE
G657	OB FLAKE	60	?	?	0.1	NOT VISIBLE
J971	CER	61	DIC	S	8.7	
J935	CH SHATTER	64	DOC	S	2.7	
G609	OB FLAKE	74	DOC	ED	110.6	MINIMAL EDGE DAMAGE
C246	CHAL FLAKE	75	?	?	1.2	NOT VISIBLE
C272	CER	76	SW-8	S	6.0	
D357	OB FLAKE	78	?	S	0.5	
G699	CER	80	?	?	0.4	NOT VISIBLE
D311	OB FLAKE	85	DOC	S	8.1	
G698	CER	88	?	?	0.2	NOT VISIBLE
G672	CER	93	DOC*	B	15.8	MULTI FRAGS
C267	CER	98	DOC	S	8.3	

*POSSIBLE FRAGS LOCATED IN SW-7,12,13,28,33,34,47,48

NE QUAD: NOT COLLECTED

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
C245	CH FLAKE	7	?	?	0.2	NOT VISIBLE
C279	CER	10	OCB	S	1.9	IN DUNGU,ON QUAD BORDER
J999	CER	14	?	?	0.1	NOT VISIBLE
J960	CHAL SHATTER	24	?	?	0.6	NOT VISIBLE
G670	CER	28	OCB	S	10.2	
G636	OB FLAKE	29	DIC	S	0.4	
J911	OB CORE	32	DOQ	S	44.4	
D386	CER	33	DIC	B	4.9	2 FRAGS
C235	OB FLAKE	34	?	?	1.2	NOT VISIBLE
C300	CER	37	?	?	0.7	NOT VISIBLE
D309	OB BIFACE	39	DOC	S	15.2	
C223	OB FLAKE	50	?	?	1.0	NOT VISIBLE
D383	CER	56	DOC	S	1.6	
J595	OB FLAKE	67	?	?	<0.1	NOT VISIBLE
D310	CER	70	DIC	S	14.7	
J1000	CER	75	DIC	S	0.2	
G658	CHAL FLAKE	89	DIC	S	0.3	
D336	OB FLAKE	90	DIC	S	0.9	
J922	OB FLAKE	92	?	?	0.7	NOT VISIBLE
D335	OB FLAKE	97	?	?	1.3	NOT VISIBLE

ARTIFACT POSITION AND CONDITION

PLOT E DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: COLLECTED						
J998	CER	11	SW-10	BD	0.1/0.1	
C206	OB FLAKE	17	SW-15	S	6.3	
D360	CHAL FLAKE	20	?	?	1.0	NOT VISIBLE
D371	CER	26	SW-22,39	B	9.3/9.3	3 FRAGS
G612	OB UNIFACE	32	DOQ	S	21.3	
J986	CER	48	CELL	S	1.1	
G634	CH FLAKE	50	CELL	S	1.8	
D385	CER	58	SW-43	S	2.3	
G660	OB FLAKE	62	?	?	<0.1	NOT VISIBLE
C282	CER	64	SW-56	BD	2.8/2.7	
D372	CER	66	SW-66,76	B	16.0/16.0	6 FRAGS
J912	OB FLAKE	67	DOQ	B	72.3/69.3	1 FRAG LOCATED
C280	CER	68	CELL	S	2.2	
C224	OB FLAKE	71	CELL	S	1.5	
G671	CER	76	SW-66,76	B	14.5/9.4	6 FRAGS LOCATED
J924	OB FLAKE	83	SW-84	B	1.9/0.5	1 FRAG LOCATED
G659	CH FLAKE	86	?	?	0.3	NOT VISIBLE
C211	CH FLAKE	91	CELL	S	13.3	
C236	OB FLAKE	92	?	?	1.4	NOT VISIBLE
J985	CER	100	DOQ	B	4.8/0.5	1 FRAG LOCATED
SE QUAD: NOT COLLECTED						
G633	CH SHATTER	5	DIC	S	5.6	
C212	CHAL SHATTER	10	DOQ	S	42.8	
J947	OB FLAKE	12	DOC	S	0.4	
D359	CH FLAKE	13	?	?	1.0	NOT VISIBLE
J970	CER	27	DOQ	S	13.2	
J948	OB FLAKE	29	?	?	0.4	NOT VISIBLE
G686	CER	34	OCB	S	1.4	
D399	CER	40	DIC	S	0.9	
D384	CER	42	DIC	S	1.7	
C259	CH FLAKE	44	?	?	1.0	NOT VISIBLE
D400	CER	52	DOC	S	0.1	
J906	OB FLAKE	58	?	?	12.8	NOT VISIBLE
J936	OB FLAKE	65	?	?	5.7	NOT VISIBLE
J972	CER	69	?	?	9.2	NOT VISIBLE
C205	OB FLAKE	74	DOC	S	19.5	
D358	CHAL FLAKE	77	?	?	0.8	NOT VISIBLE
C260	OB FLAKE	78	?	?	0.1	NOT VISIBLE
D312	CH FLAKE	82	DOC	S	12.0	
C281	CER	92	?	?	2.1	NOT VISIBLE
C299	CER	97	DIC	S	0.9	

ARTIFACT POSITION AND CONDITION

PLOT L DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
NW QUAD: COLLECTED						
E485	CER	3	IN SITU	S	2.5	
H736	OB FLAKE	4	OCB	S	1.3	
H760	CH SHATTER	5	OCB	S	0.6	
E479	CER	14	?	?	1.4	NOT VISIBLE
H759	CHAL FLAKE	19	IN SITU	S	0.3	
E466	CER	21	DOC	S	6.4	
E460	OB FLAKE	23	DIC	S	0.4	
E486	CER	27	?	?	1.3	NOT VISIBLE
E405	CH SHATTER	29	DOQ	S	20.7	
E494	CER	26	OCB	S	2.4	
E459	OB FLAKE	46	DOC	S	0.5	
E471	CER	52	DIC	S	9.0	
E429	OB FLAKE	54	IN SITU	S	2.0	
E436	OB FLAKE	72	DIC	S	1.9	
E472	CER	75	OCB	S	5.7	
E428	OB SHATTER	79	DIC	S	4.7	
E446	OB FLAKE	87	?	?	0.1	NOT VISIBLE
E434	OB FLAKE	90	OCB	S	4.9	
E500	CER	99	IN SITU	S	0.5	
E447	OB FLAKE	100	?	?	0.1	NOT VISIBLE
NE QUAD: NOT COLLECTED						
F571	CER	20	DIC	S	6.0	
F523	OB FLAKE	26	OCB	S	2.8	
F524	CH FLAKE	30	?	?	1.6	NOT VISIBLE
F535	CH SHATTER	34	DOC	S	2.4	
F504	OB FLAKE	38	OCB	S	67.0	
F565	CER	51	DIC	S	6.8	
F536	OB FLAKE	54	?	?	2.3	NOT VISIBLE
F513	OB FLAKE	58	DIC	S	1.6	
F566	CER	60	DIC	S	3.4	PARTIALLY BURIED
F519	CHAL FLAKE	62	?	?	8.3	NOT VISIBLE
H724	OB FLAKE	63	DIC	S	3.3	
F578	CER	65	DIC	E	6.7	2 FRAGS
H785	CER	67	DIC	S	2.8	
H800	CER	71	?	?	0.2	NOT VISIBLE
F512	OB FLAKE	73	IN SITU	S	31.2	
E445	OB SHATTER	74	IN SITU	S	1.4	
H735	CH FLAKE	85	DOC	S	7.9	
F547	OB FLAKE	87	DOC	S	<0.1	
B180	CER	95	OCB	S	7.9	
H772	CER	98	OCB	E	7.6	2 FRAGS

ARTIFACT POSITION AND CONDITION

PLOT L DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
SW QUAD: NOT COLLECTED						
B172	CER	2	OCB	B	20.2	ON QUAD BORDER, 17 FRAGS
B136	OB FLAKE	5	DOC	S	0.4	
B780	CER	8	DOC	B	4.9	2 FRAGS
B111	OB FLAKE	9	DOC	S	9.9	
B799	CER	13	DIC	B	0.7	2 FRAGS
B123	OB FLAKE	20	IN SITU	S	5.8	
B186	CER	27	?	S	2.0	
B160	CH FLAKE	35	DOC	S	0.7	
B159	OB FLAKE	36	?	?	<0.1	NOT VISIBLE
B112	OB SHATTER	37	IN SITU	S	23.0	
B200	CER	38	OCB	B	0.1	2 FRAGS
B124	OB FLAKE	39	DOC	S	2.1	
B167	CER	51	OCB	S	21.4	
B199	CER	58	DIC	B	<0.1	2 FRAGS
B105	OB CORE	61	DOQ	S	44.5	
B179	CER	69	DIC	S	2.3	
B135	OB FLAKE	76	OCB	S	1.0	
B148	CHAL SHATTER	79	?	?	1.0	NOT VISIBLE
B104	OB FLAKE	85	OCB	S	6.6	
B147	OB FLAKE	92	OCB	S	0.3	
SE QUAD: COLLECTED						
B166	CER	2	CELL	B	9.2/9.2	6 FRAGS
H726	OB FLAKE	6	CELL	S	1.6	
F586	CER	8	SE-7/8	S	2.3	
H712	OB SHATTER	10	SE-27	S	26.9	
H747	OB FLAKE	12	?	?	<0.1	NOT VISIBLE
F579	CER	13	CELL	S	2.4	
F548	OB FLAKE	15	SE-27	ED	0.1/0.1	
J767	CER	21	CELL,DOQ	B	6.4/4.1	2 FRAGS LOCATED
A28	CH FLAKE	45	SE-44	ED	2.7/2.1	
H779	CER	53	CELL	B/ED	1.5/1.4	2 FRAGS
H786	CER	59	SE-61	B/ED	2.3/2.2	2 FRAGS
H705	OB FLAKE	66	CELL	S	20.7	
H748	CH FLAKE	74	SE-75	ED	0.1/0.1	
H704	OB FLAKE	76	CELL	S	18.3	
H709	OB FLAKE	82	SE-99/100	S	54.7	
E424	OB FLAKE	85	CELL	S	4.8	
F559	OB FLAKE	88	?	?	0.2	NOT VISIBLE
F560	OB SHATTER	89	?	?	0.6	NOT VISIBLE
F600	CER	95	CELL	S	0.9	
E411	OB FLAKE	97	CELL	S	10.7	

ARTIFACT POSITION AND CONDITION

CONTROL PLOT DISTURBANCE: Livestock/Wildlife

Artifact Number	Type	Original Cell	New Positions	Condition	Weight-gms (orig/new)	Comments
A86	CER	4	IN SITU	S	4.8	
I810	OB FLAKE	12	IN SITU	S	99.3	
I835	OB FLAKE	13	DIC	S	2.4	
I809	OB FLAKE	17	IN SITU	S	5.0	
A36	OB FLAKE	18	IN SITU	S	3.6	
I886	CER	20	IN SITU	S	1.0	
I857	OB FLAKE	22	IN SITU	S	0.7	
A85	CER	24	IN SITU	S	7.9	
A29	OB FLAKE	29	IN SITU	S	7.0	
A100	CER	30	?	?	0.1	NOT VISIBLE
I858	OB FLAKE	40	IN SITU	S	0.8	
I859	OB SHATTER	42	DIC	S	1.4	
A84	CER	48	IN SITU	S	4.5	
A6	OB SHATTER	57	?	?	27.7	NOT VISIBLE
I860	OB FLAKE	59	DIC	S	0.8	
A72	CER	63	IN SITU	S	11.8	
A79	CER	85	IN SITU	S	4.1	
A12	OB FLAKE	86	IN SITU	S	13.5	
A35	OB FLAKE	88	IN SITU	S	2.9	
I871	CER	98	OCB	S	14.8	

KEY

CH	=	CHERT
CHAL	=	CHALCEDONY
OB	=	OBSIDIAN
CER	=	CERAMIC
IN SITU	=	IN ORIGINAL HORIZONTAL POSITION
IN DUNGU	=	UNDER COW EXCRETEMENT
DIC	=	DISPLACED IN CELL
DOC	=	DISPLACED OUT OF CELL
DOQ	=	DISPLACED OUT OF QUAD
OCB	=	ON CELL BORDER
CELL	=	WITHIN ORIGINAL CELL
?	=	INDETERMINATE POSITION
##/##	=	LOCATED ON BORDER BETWEEN TWO (OR MORE) CELLS
##,##	=	FRAGMENTS LOCATED IN TWO (OR MORE) CELLS
E	=	EXFOLIATED OR SPALLING HORIZONTALLY (CERAMICS)
ED	=	EDGE DAMAGE
B	=	BROKEN
S	=	SAME CONDITION OR NO OBSERVED DAMAGE
FRAGS	=	FRAGMENTS
VERT	=	VERTICAL
POS	=	POSITION

APPENDIX II

ARTIFACT PLOT DRAWINGS

Artifact Location and Condition

Collected

★	Original Position
●	New Position
•●	New Position - Fragments
⍟	Within Original Cell
⦿	Fragments Within Original Cell
✪	Not Visible
?	Exact Position Not Recorded

Not Collected

★	Original Position or In Situ
●	New Position
•●	New Position - Fragments
⍟	Displaced Within Cell
⦿	Fragments Within Original Cell
✪	Not Visible
?	Exact Position Not Recorded

Figure 1. Key to artifact plot symbolization.

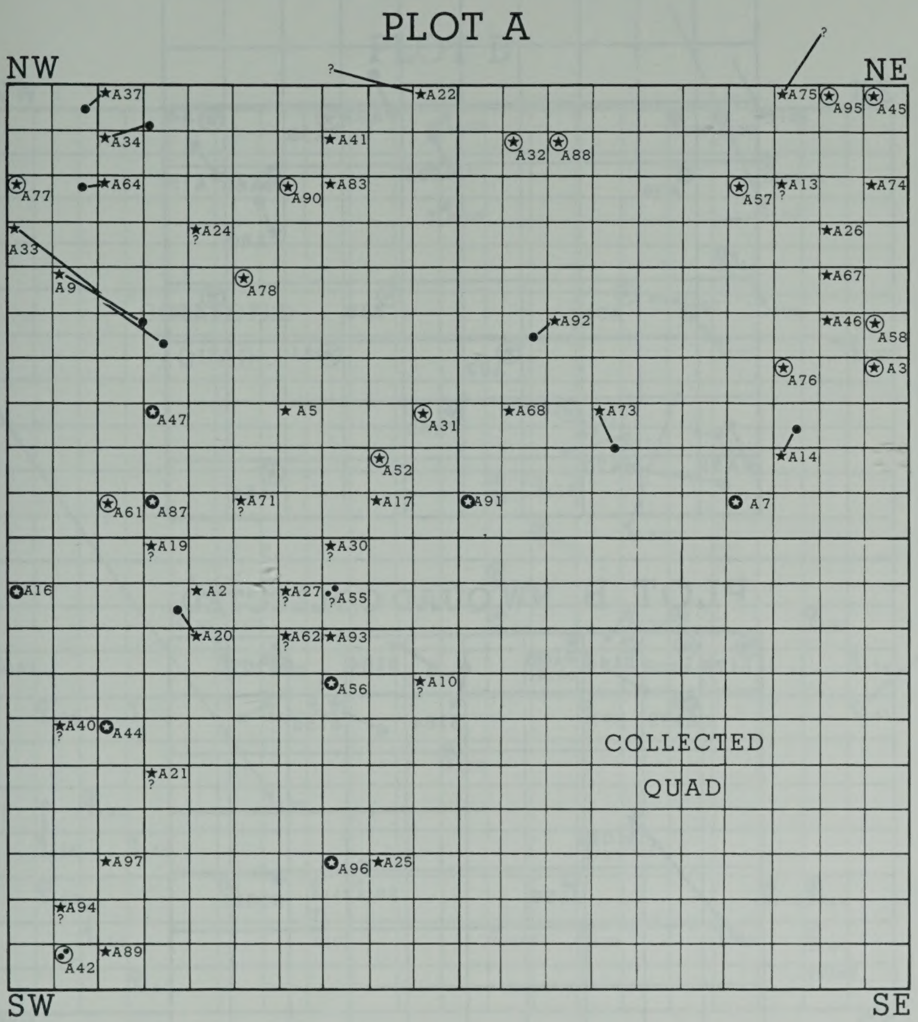
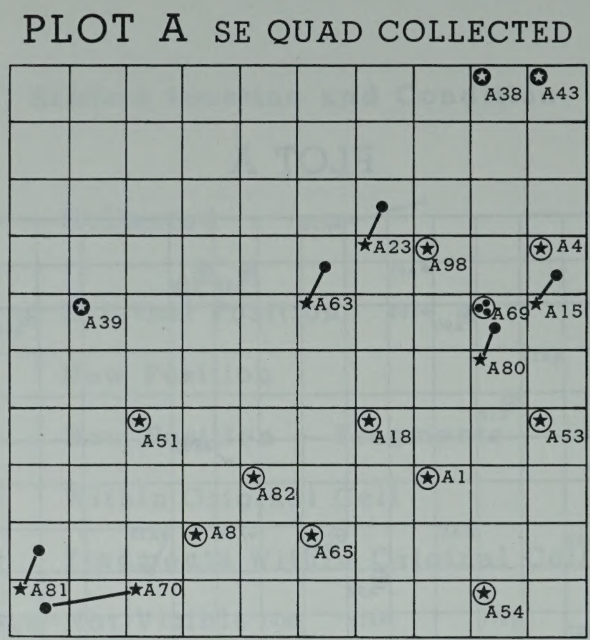


Figure 2. Plot A.



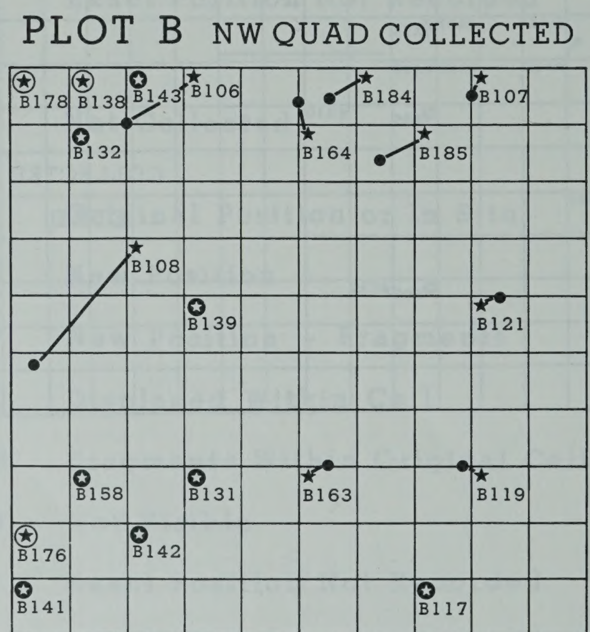


Figure 3. Plots A and B, Collected quads.

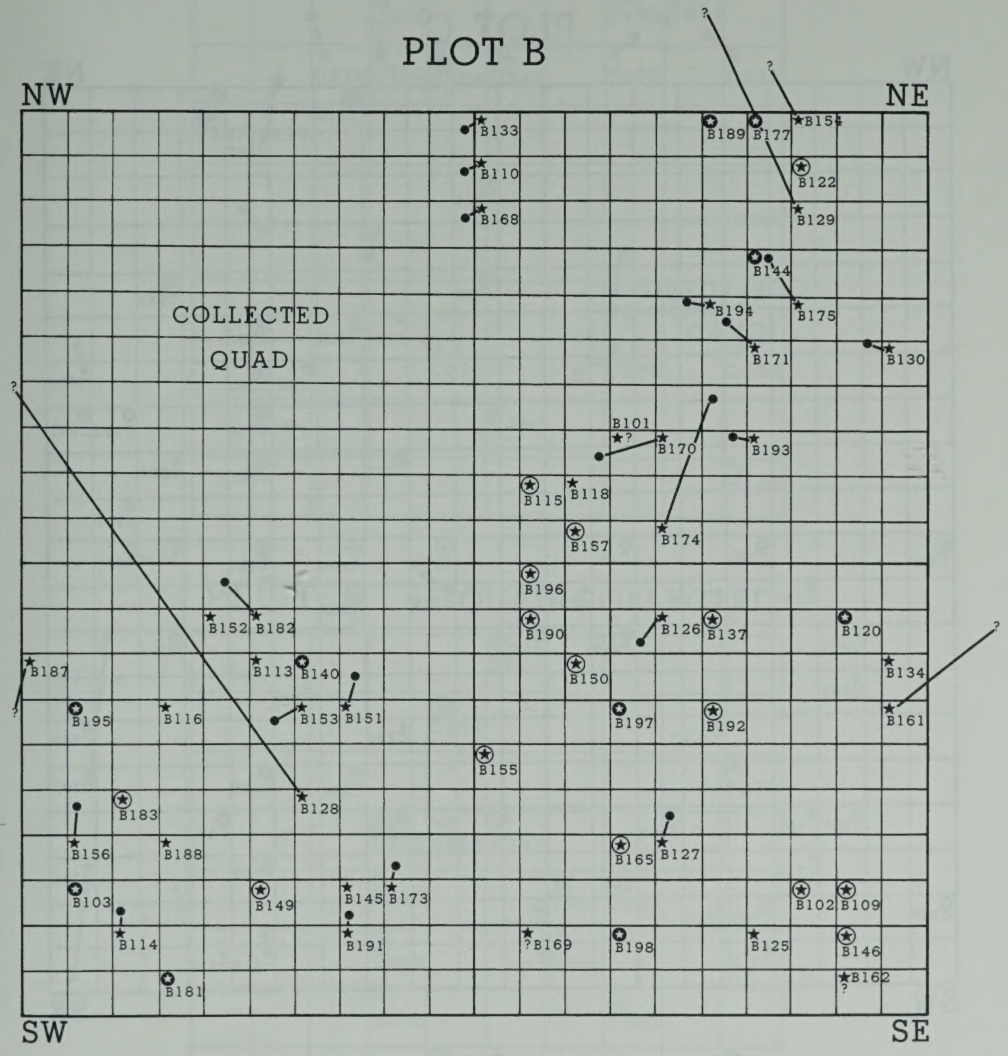


Figure 4. Plot B.

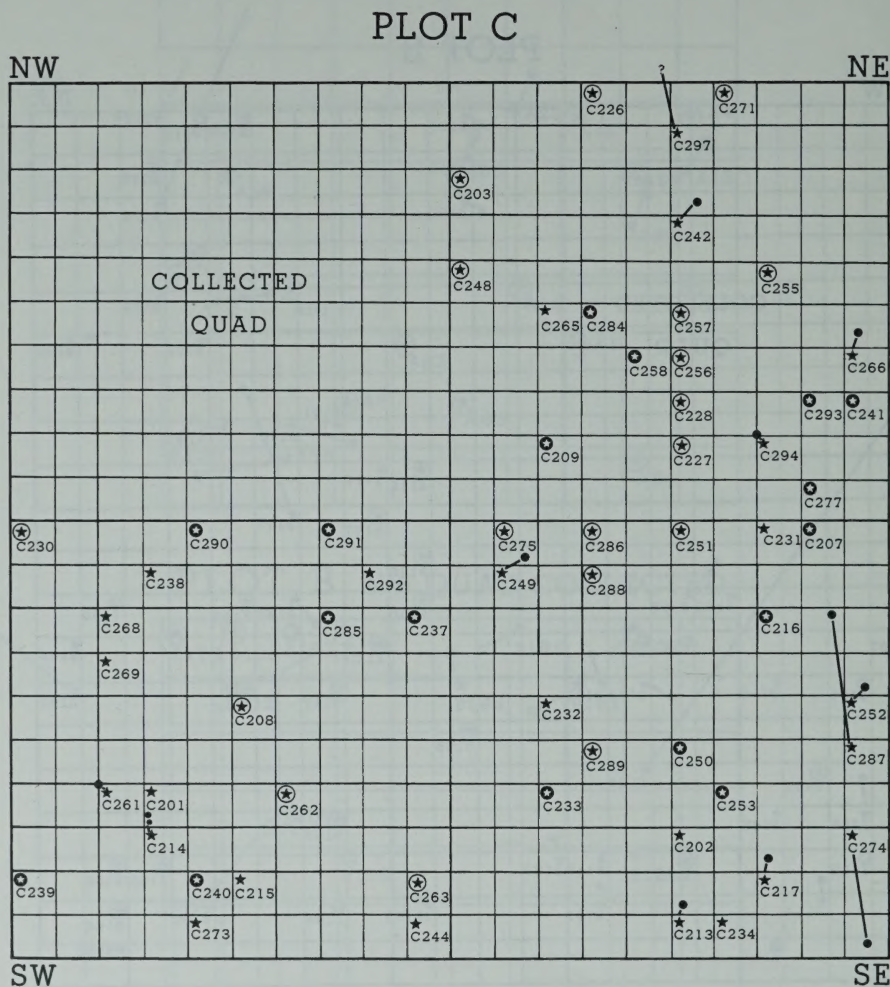
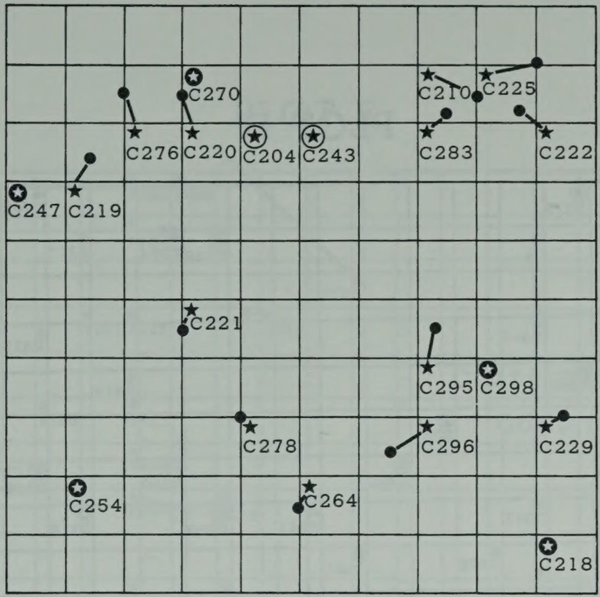


Figure 5. Plot C.

PLOT C NW QUAD COLLECTED



PLOT D SE QUAD COLLECTED

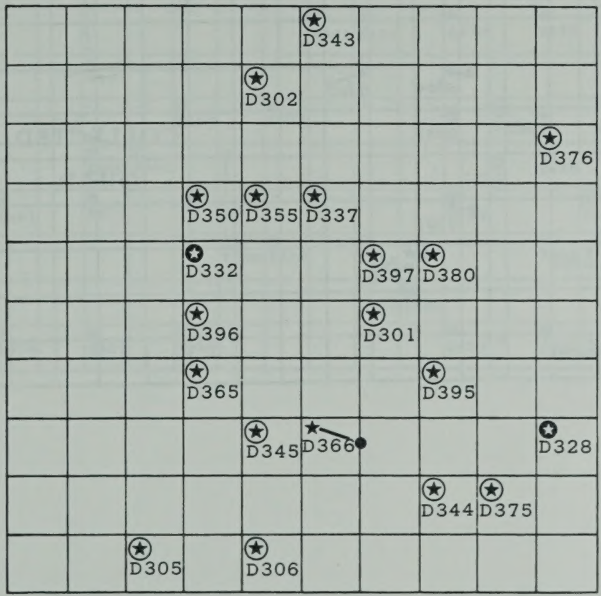


Figure 6. Plots C and D, Collected quads.

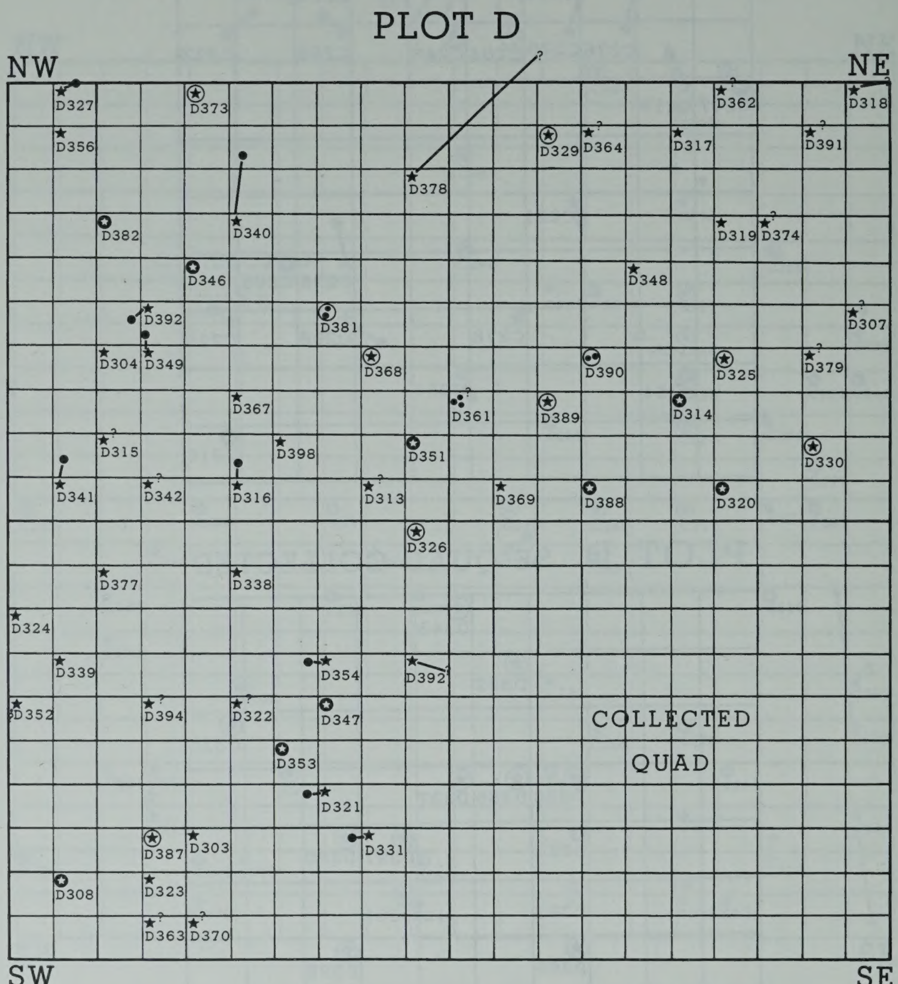


Figure 7. Plot D.

PLOT E

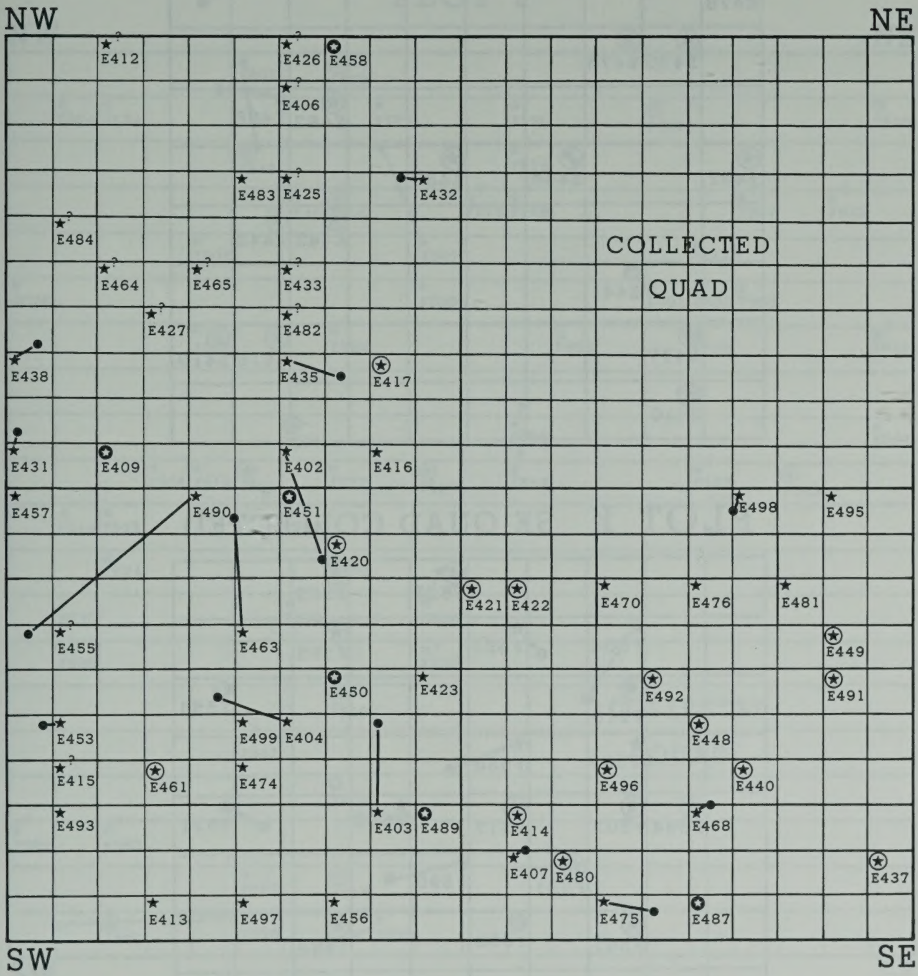
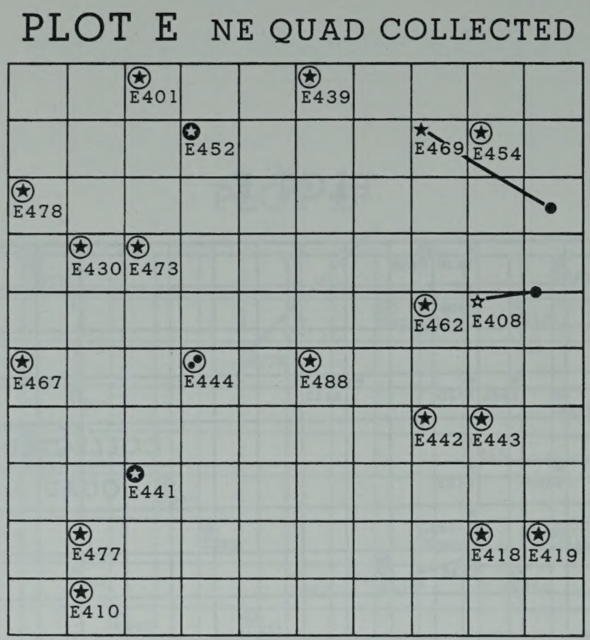


Figure 8. Plot E.



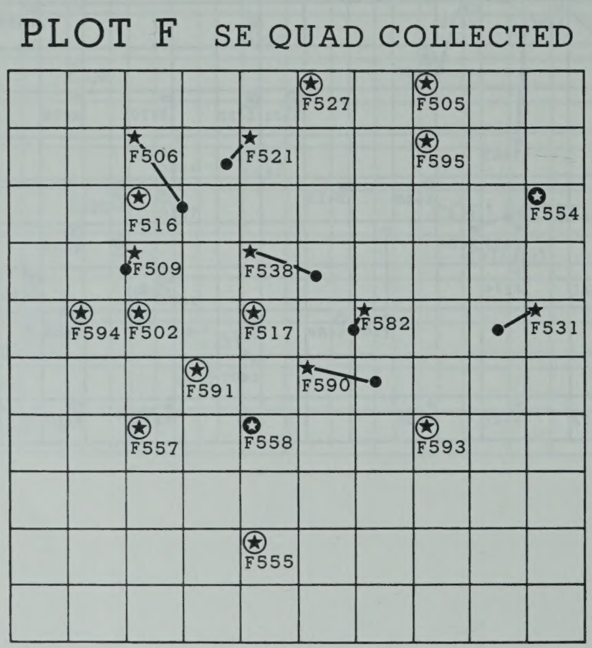


Figure 9. Plots E and F, Collected quads.

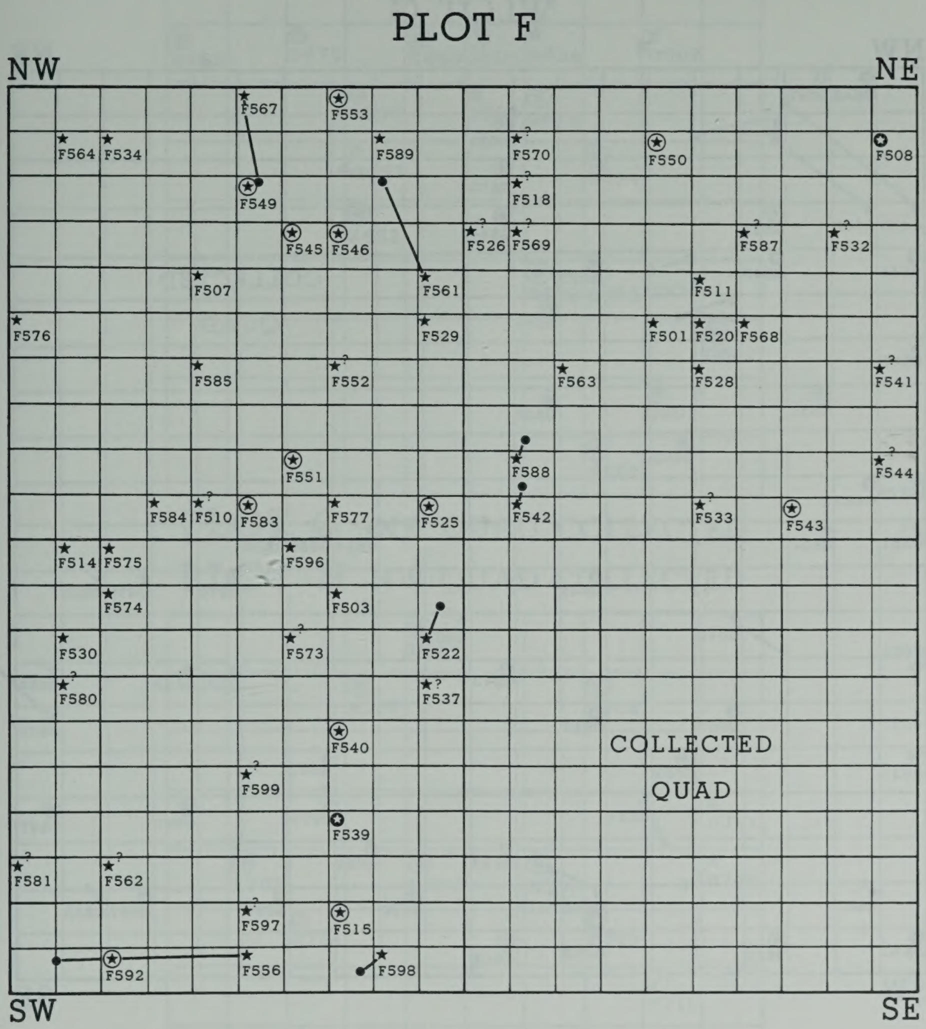


Figure 10. Plot F.

PLOT G

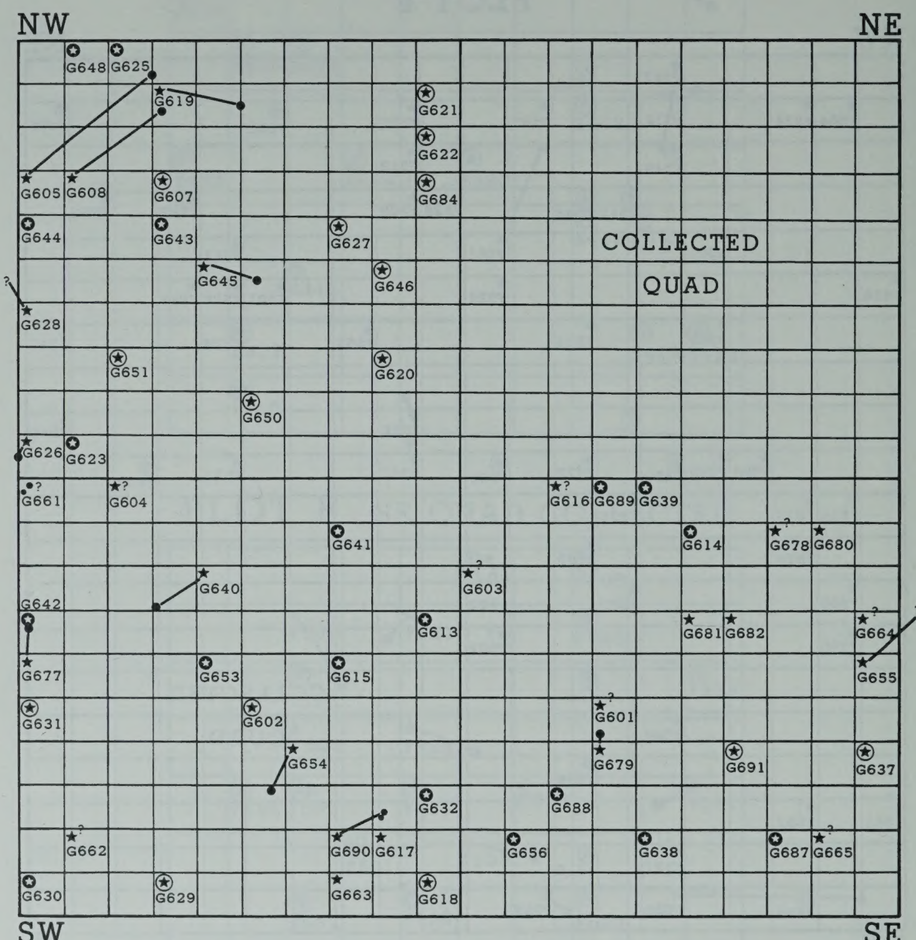


Figure 11. Plot G.

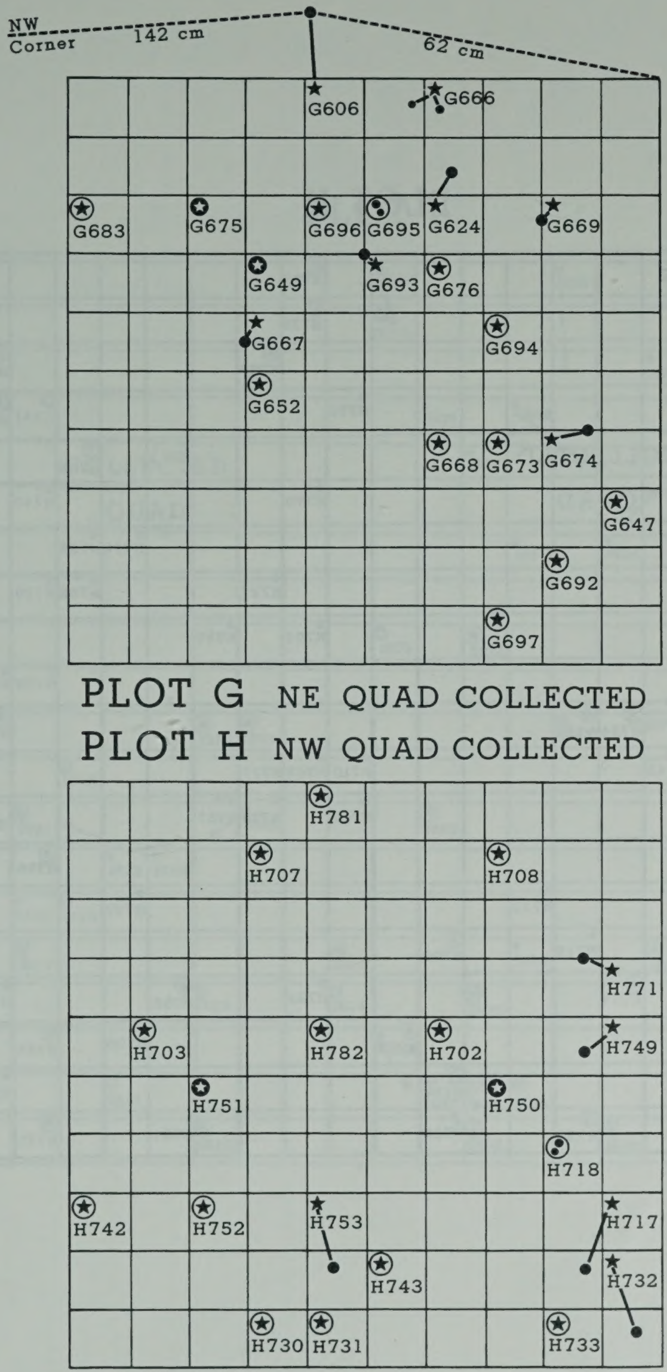


Figure 12. Plots G and H, Collected quads.

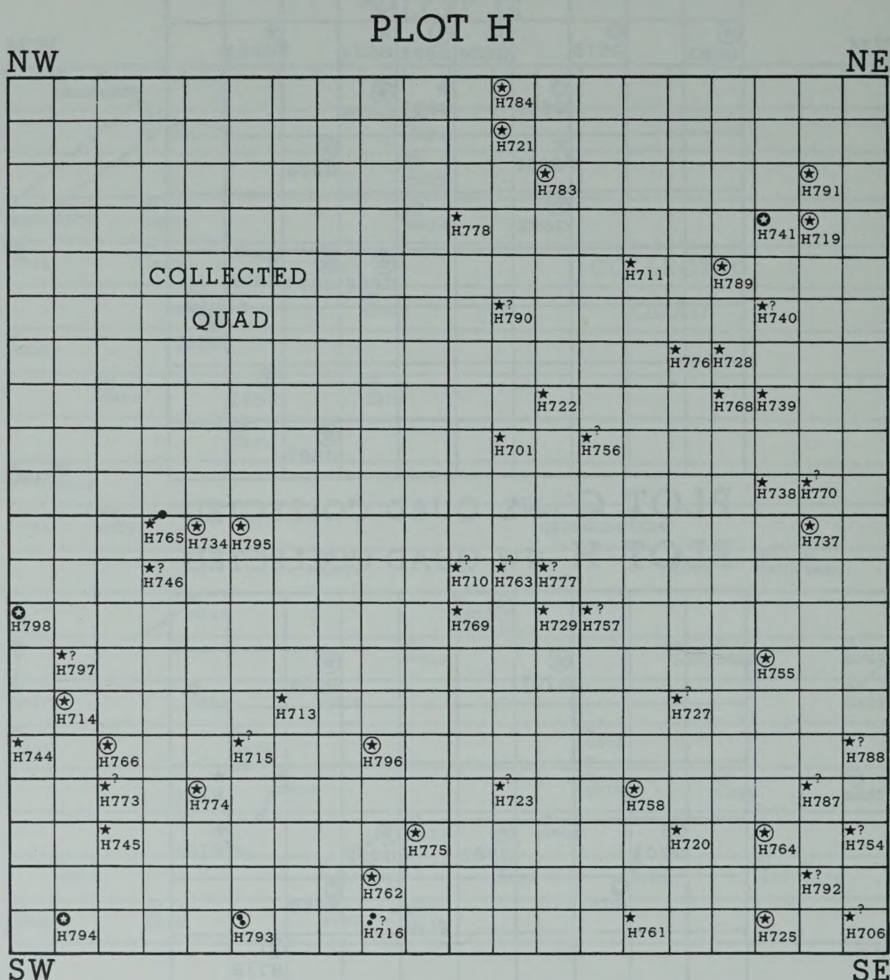


Figure 13. Plot H.

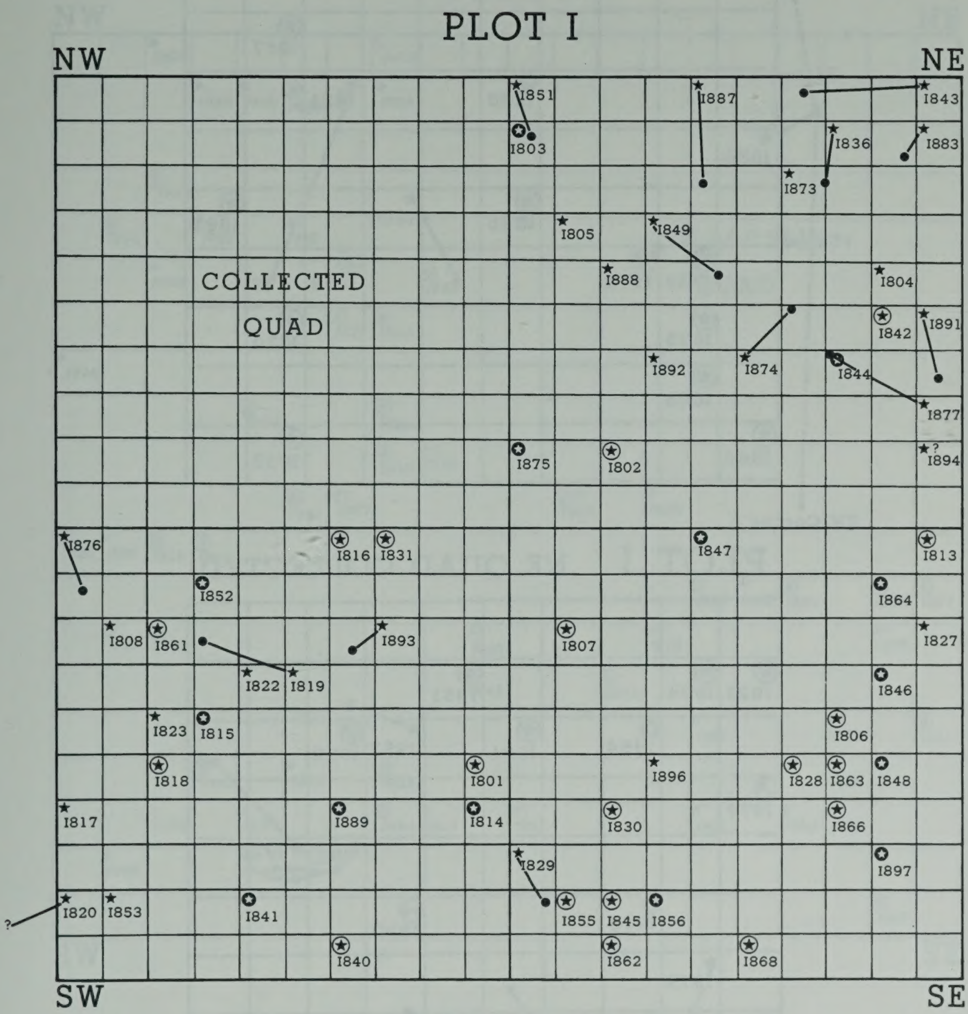
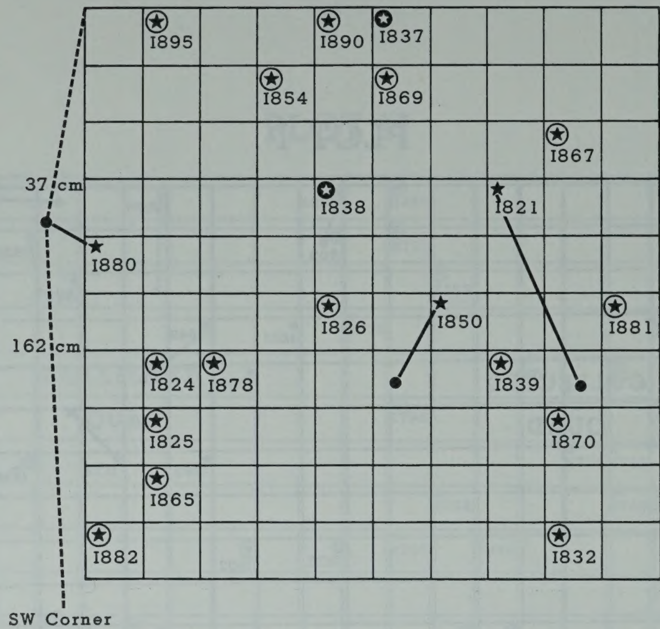


Figure 14. Plot I.

PLOT I NW QUAD COLLECTED



PLOT J NE QUAD COLLECTED

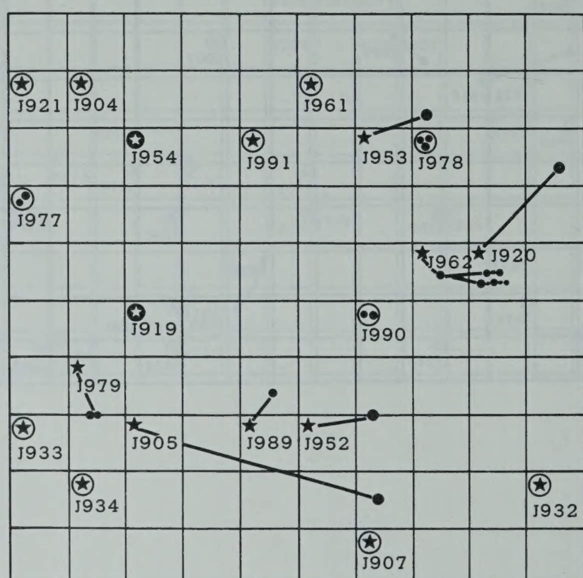


Figure 15. Plots I and J, Collected quads.

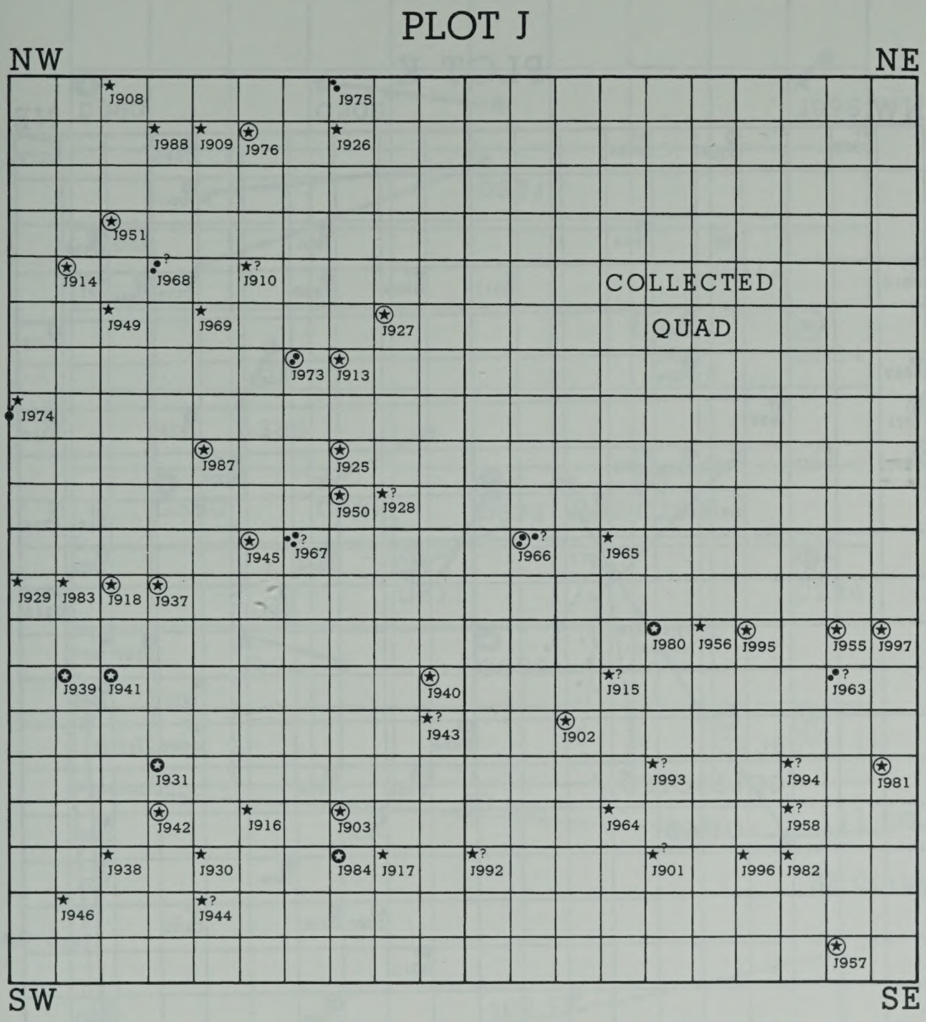


Figure 16. Plot J.

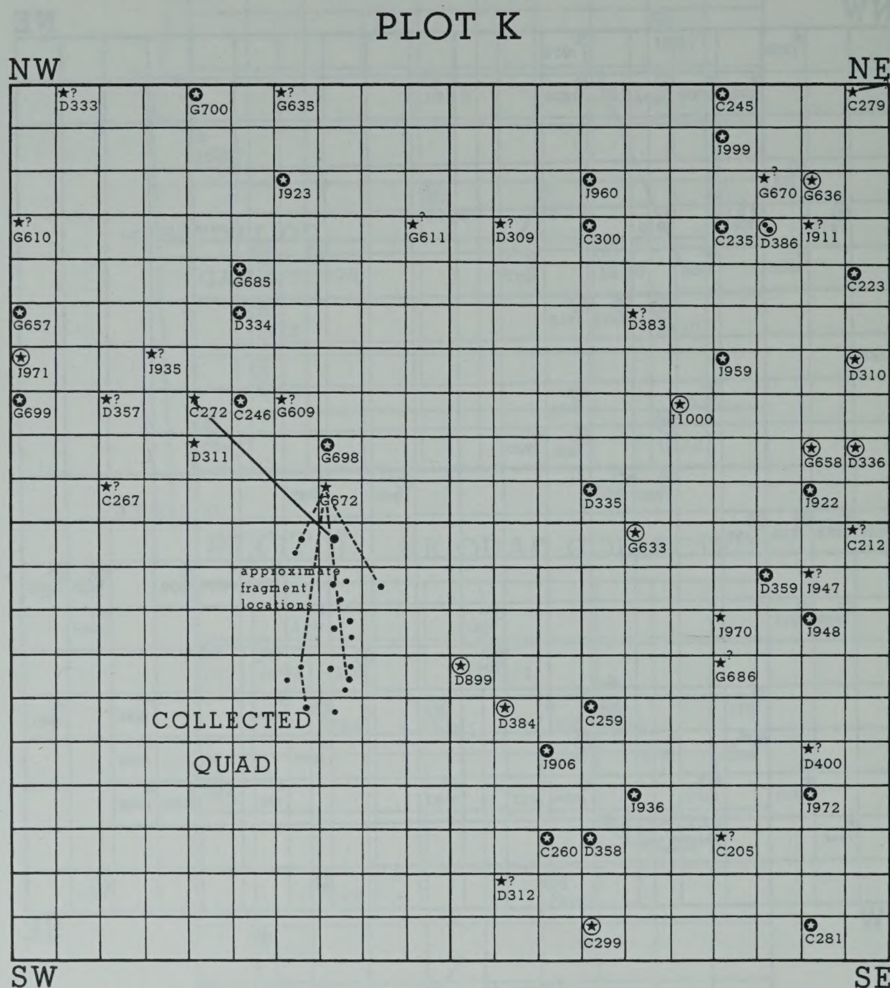


Figure 17. Plot K.

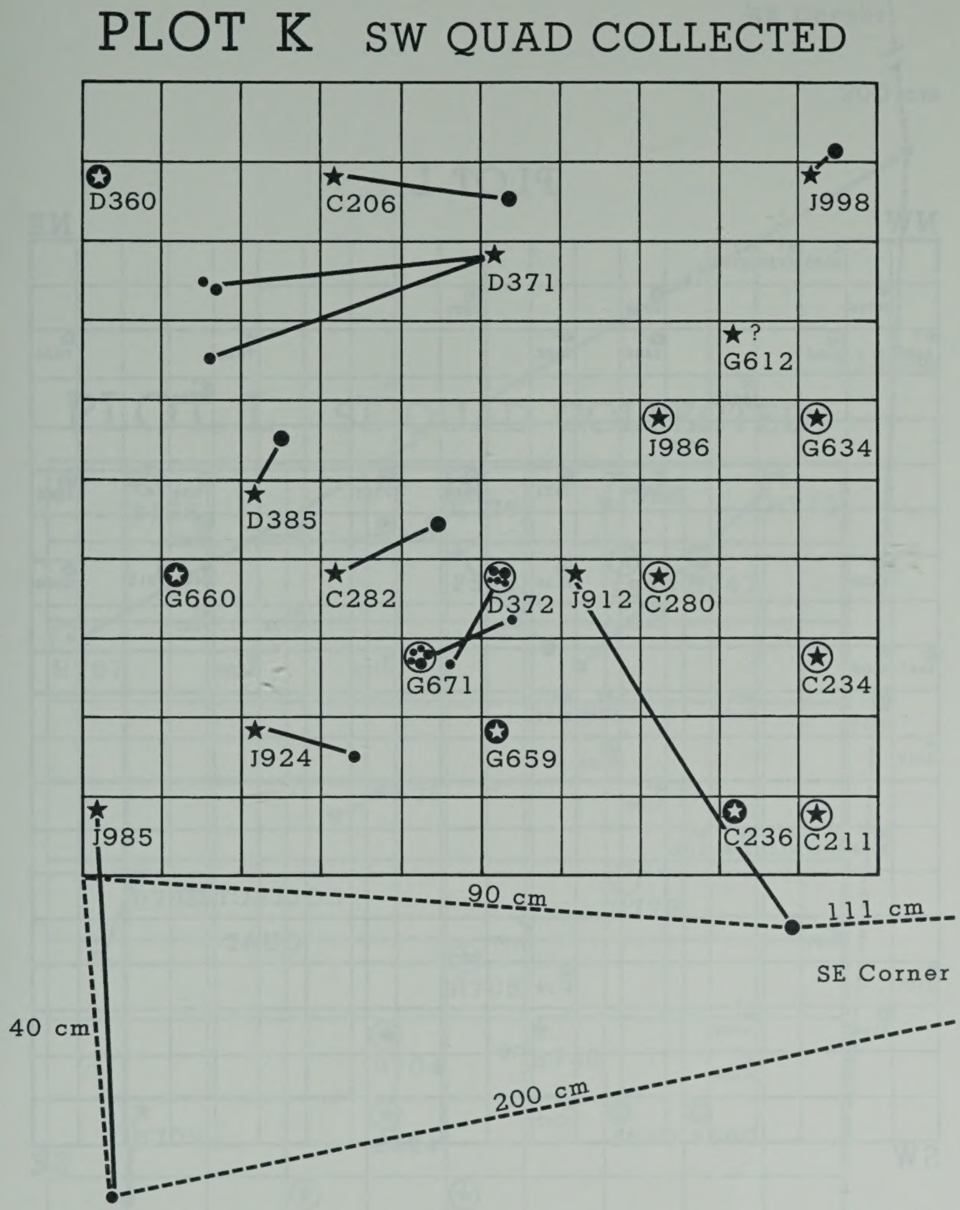


Figure 18. Plot K, Collected quad.

PLOT L

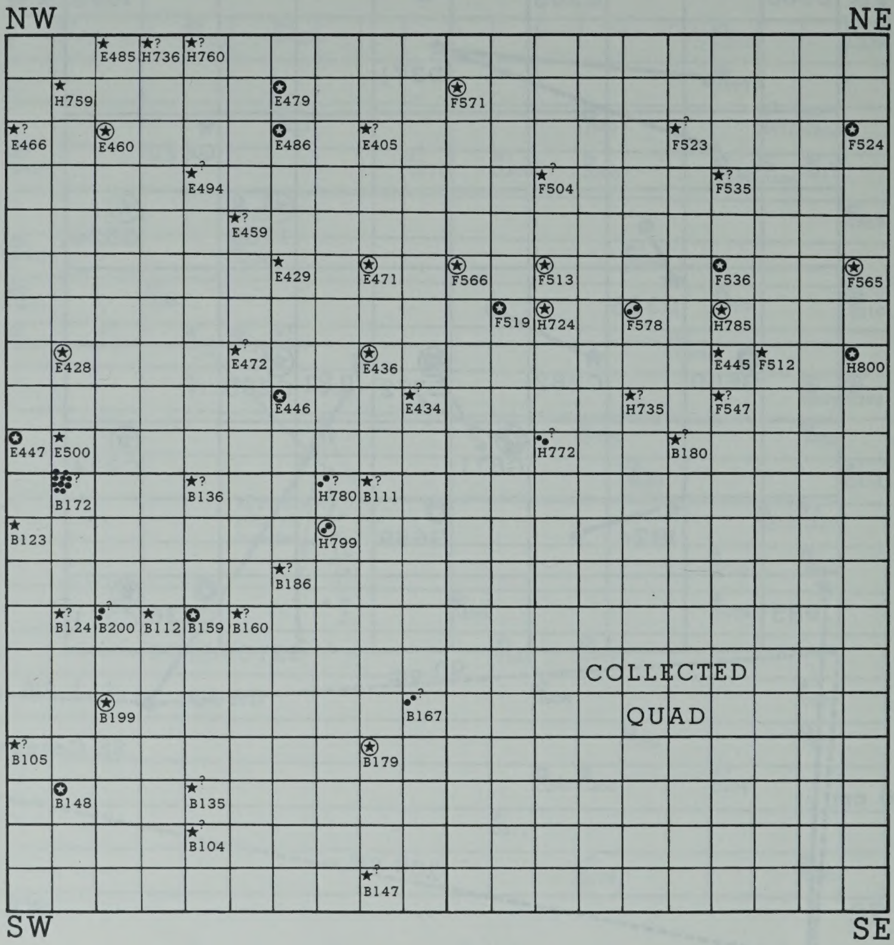


Figure 19. Plot L.

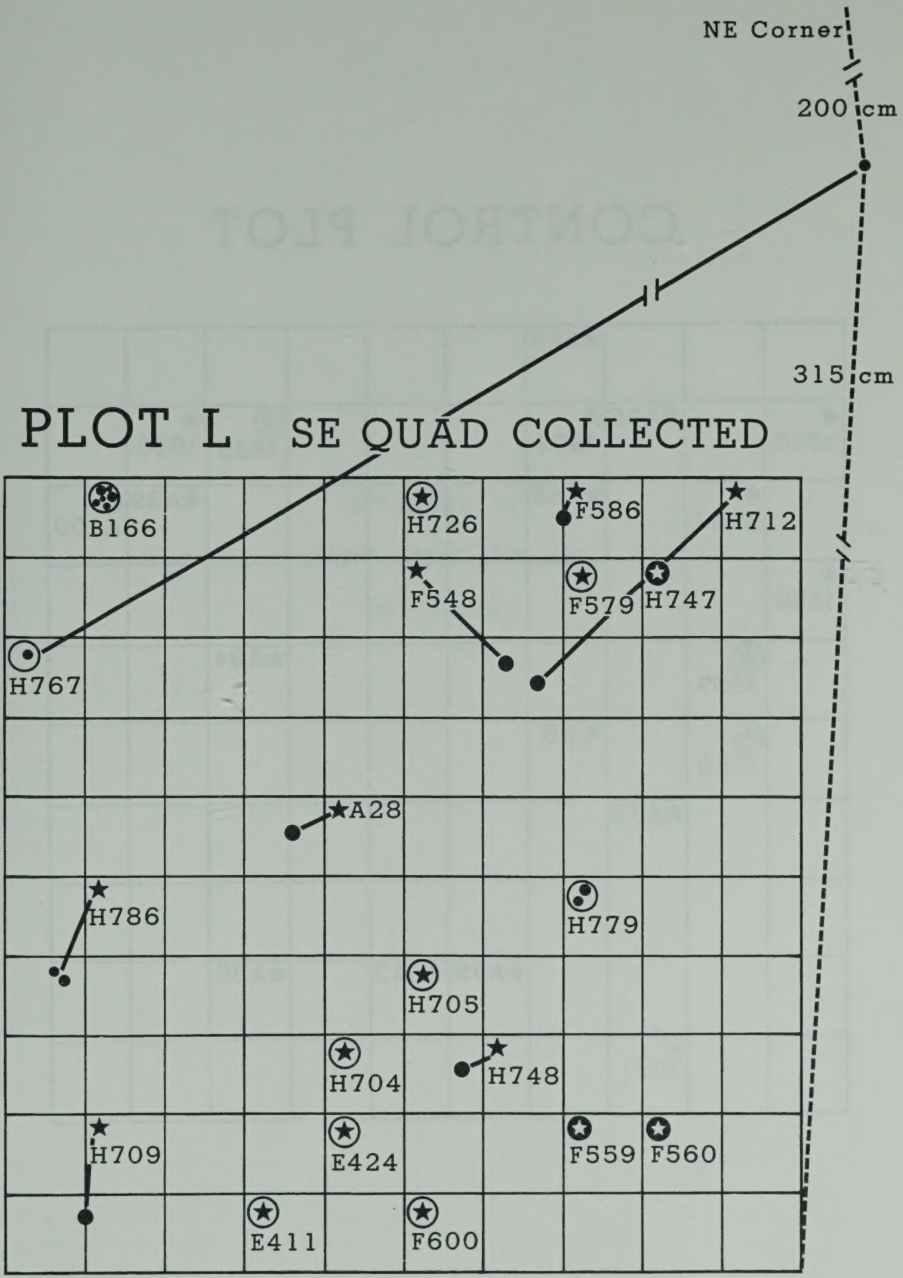


Figure 20. Plot L, Collected quad.

CONTROL PLOT

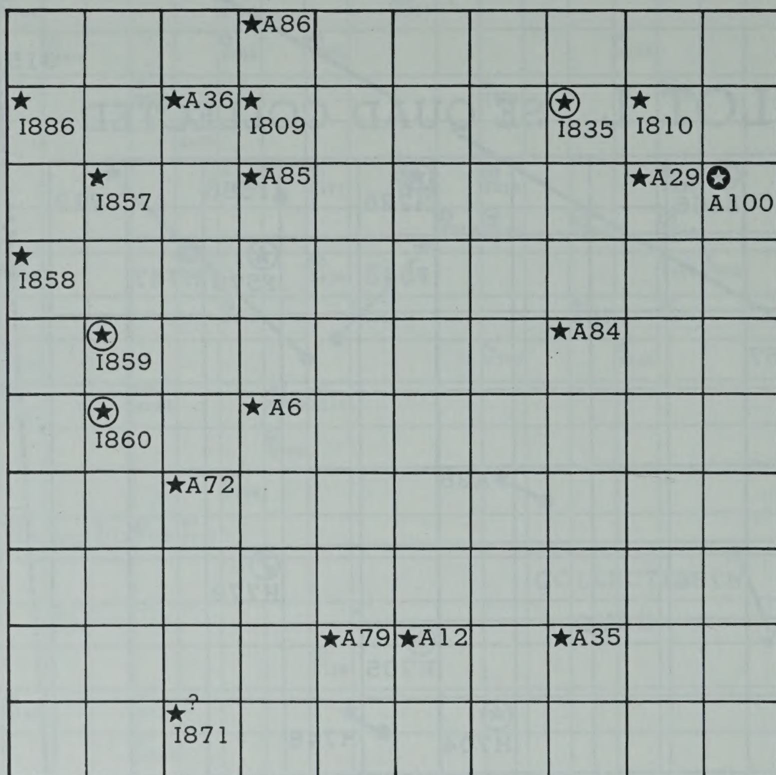


Figure 21. Control Plot.

APPENDIX III

SITE DESCRIPTIONS

(S. Vetter)

APPENDIX III

SITE DESCRIPTIONS

42WN1652

This rockshelter sits above Hartnet Draw on the north at elevation 1890 m (Fig. 1). The site was recorded by the University of Nebraska crew in September 1985. The mouth of the rockshelter faces southeast at N140oE. The rockshelter is 150 m northwest of the South Desert road and 11 m above it. Thus, the grade up to the site is over seven percent. The mouth of the shelter extends nine meters across and reaches a height of 2.66 m (Figs. 2-3). The shelter is located in the Salt Wash sandstone member of the Morrison Formation (Smith et al. 1963, Plate I). Conglomeratic sandstone beds characterize this member. 42WN1652 occurs in one of these conglomeratic beds.

Cultural materials at the site consist of a lithic scatter with a few ground stone fragments. The scatter extends from the road upslope to the site (Fig. 4). Density on this slope varies from 0.05/m2 to 0.1/m2. The soil on the slope is decomposed conglomeratic sandstone. A sparse vegetative cover includes saltbush (Atriplex canescens var.), broom snakeweed (Gutierrezia sarothrae), Indian rice grass (Oryzopsis hymenoides), sand dropseed (Sporobolus cryptandrus), alkali sacaton (Sporobolus airoides), blue grama (Bouteloua gracilis), prickly pear cactus (Opuntia sp.), sagebrush (Artemesia sp.), and rabbitbrush (Chrysothamnus sp.). Russian thistle (Salsola iberica), alkali sacaton, and saltbush are particularly dense at the mouth of the shelter. A small drainage created by water pouring off the top of the shelter has carried flakes down to the road and probably into Hartnet Draw. Flake density is slightly higher in this small drainage than it is on the rest of the slope.

The ledge above the site is eight meters high. Utah juniper (Juniperus osteosperma), cliffrose (Cowania mexicana var: stansburiana), buffaloberry (Shepherdia rotundifolia), and Mormon tea (Ephedra sp.) grow on this ledge. The ledge contains no cultural material.

Cultural debris within the shelter is obscurred by a 10 cm to 20 cm thick layer of cow dung (cf. Fig. 3). The floor of the shelter extends four meters. A ledge with a packrat midden on it extends another four meters into the rock. Firewood is piled in the north corner of the shelter. Because of the dung, no cultural material is visible on the floor of the shelter. The roof of the shelter has been fire blackened. At the dripline, where the cow dung has been eroded away, cores of chalcedony and primary flakes appear. The maximum density of lithic material at the dripline is 10/m2. Two fragments of ground stone lie near the south end of the shelter. The cow dung, undoubtedly, obscures the main concentration of lithic materials.

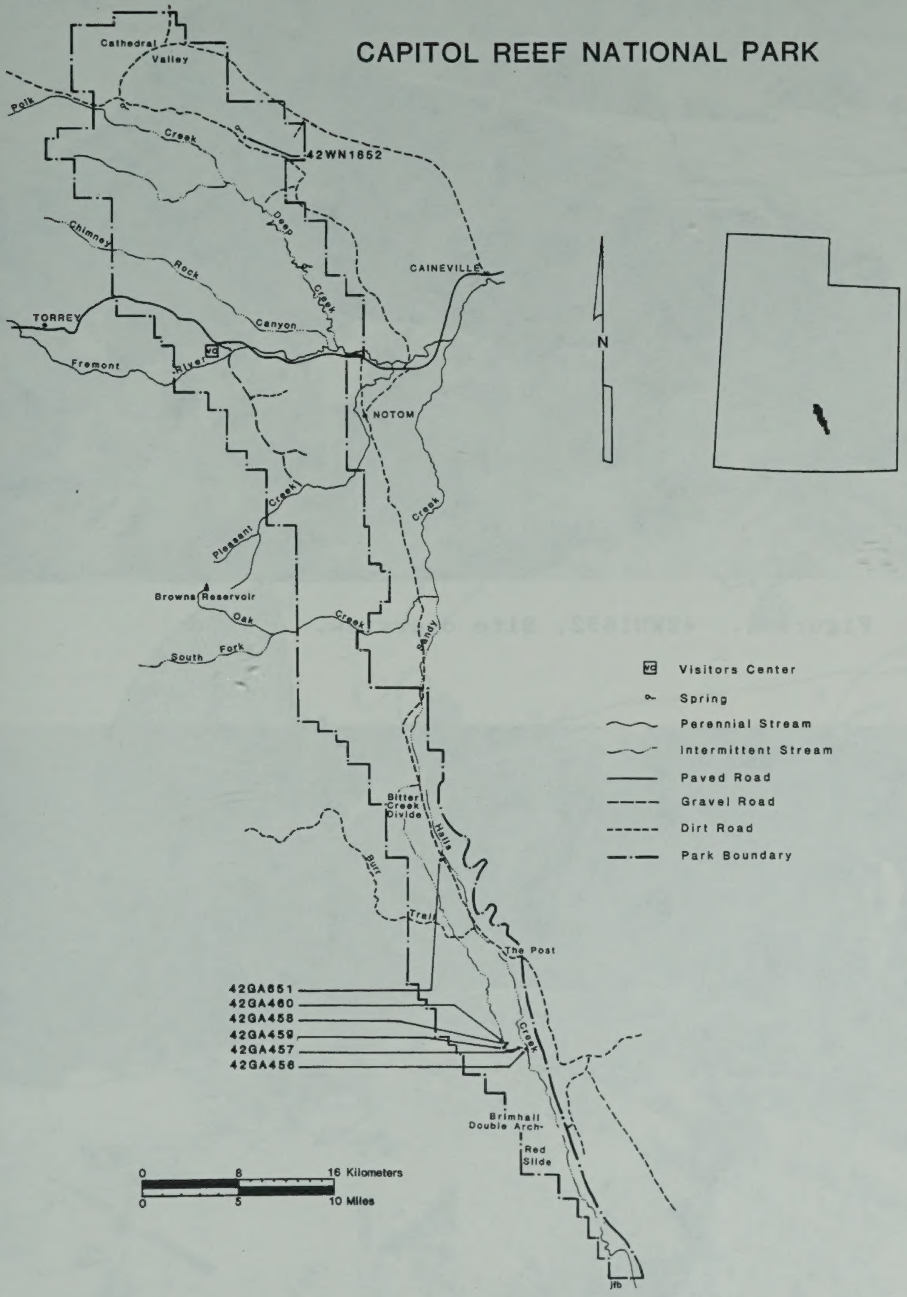


Figure 1. Capitol Reef National Park with locations of sites discussed in Appendix III.

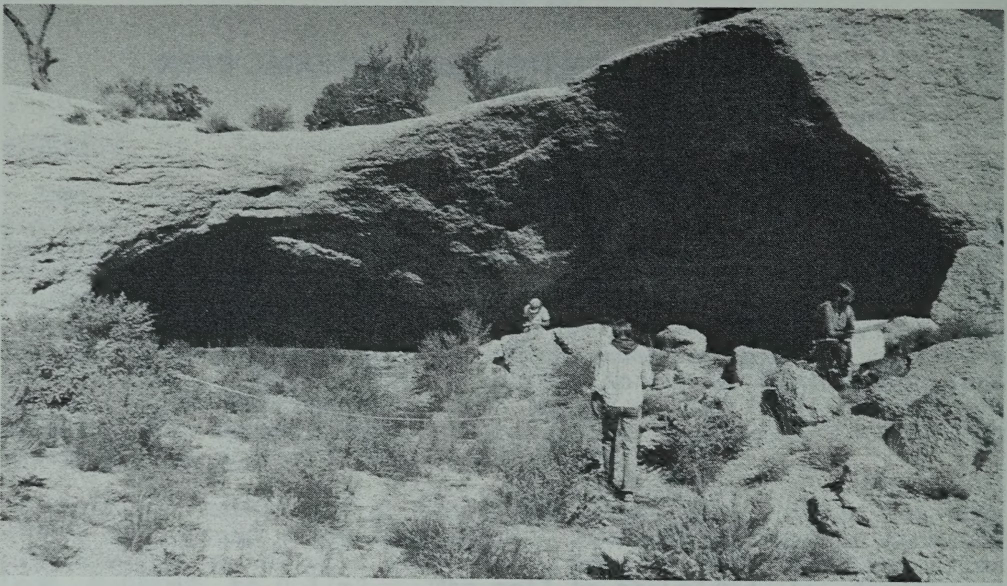


Figure 2. 42WN1652, Site overview.

Figure 3. 42WN1652, View into shelter.

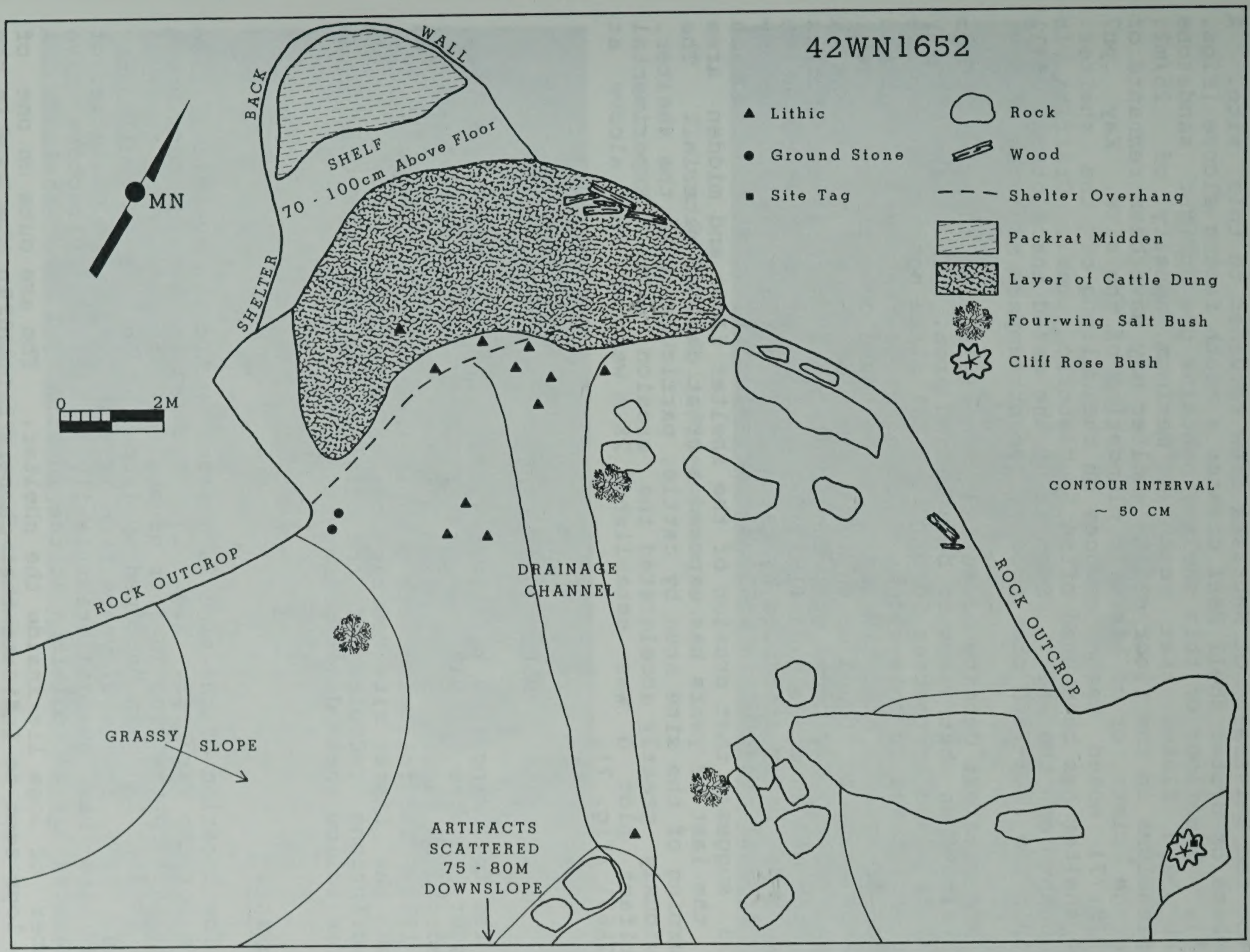


Figure 4. 42WN1652, Site map.

42GA651

Marvin Kay recorded this site in 1973 (see Kay 1973:77). In 1985 the University of Nebraska crew returned to this site. A hogback of Oyster Shell Reef creates a south facing alcove (Figs. 5-6). The floor of this shelter contains one upright sandstone slab and flakes that reach a maximum density of 25/m2. Depressions in the floor of the shelter may have been remnants of storage cists or of historic plundering of the site. Kay .pn7 (1973:77) noted carbon smudges on the ceiling of the shelter. The shelter has been used often in historic times. Graffiti is abundant on the wall. Several of the dated inscriptions fall within the 1902-1909 time period; recent campers made the others.

The greatest density of surface materials lies downslope from the alcove on what seems to be a midden area. The flake density on this slope approaches 50/m2. Several plain pottery sherds are also scattered on this slope. Ground stone fragments litter the area as well. Historic trash can be found over the site area. Flakes can be found up to 100 m south of the alcove across a small wash. Kay noted only the presence of charcoal and flakes in the midden area. He (1973:77) also commented that the site had been "badly disturbed by cattle." The abundance and variety of material observed in 1985 as contrasted with that observed in 1973 suggests that erosion of the shelter floor and midden area in the last 12 years has exposed a great deal of material. The churning of the site area by cattle, particularly in the shelter, obviously greatly accelerated the erosion rate. Experimental artifact plot G was established 28 m west of the alcove at 42GA651 (Fig. 7).

MULEY TWIST CANYON SITES

The following five sites were originally recorded by Robert H. Lister and crew in 1958 (see Lister 1959). The site locations are recorded on Figure 1. The condition of the sites was reassessed in 1985. The following site descriptions note only discrepancies with the Lister site descriptions or additions to those site descriptions. Copies of the original University of Utah site forms follow these descriptions in Appendix IV.

42GA456

The location of the site is correct on the archeological base maps for the Park (cf. Fig. 1). Buckles in his site form noted "a little pothunting in rear of shelter" in 1958. The front of the shelter had been "scooped up (about 1' deep) by a bulldozer" (Fig. 8). In the 27 years from 1958 to 1985, the character of the site has changed dramatically. Illegal collectors have excavated large portions of the interior of the shelter. A number of logs lie inside the shelter. The axe cuts on one of the logs seem to indicate that campers brought in the logs in the last 30 years. Cattle dung has been deposited in the interior of

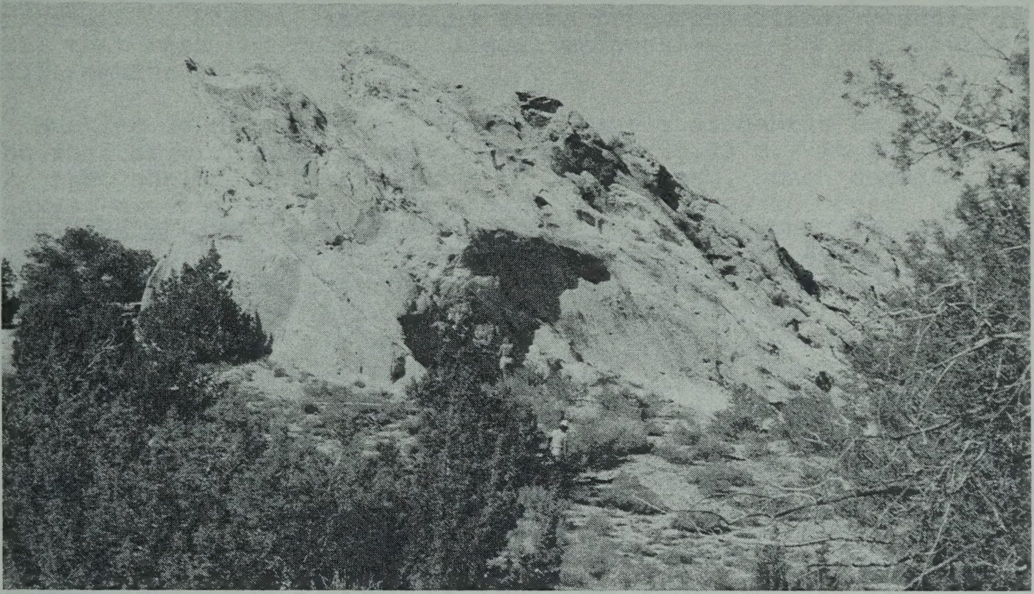


Figure 5. 42GA651, Site overview.

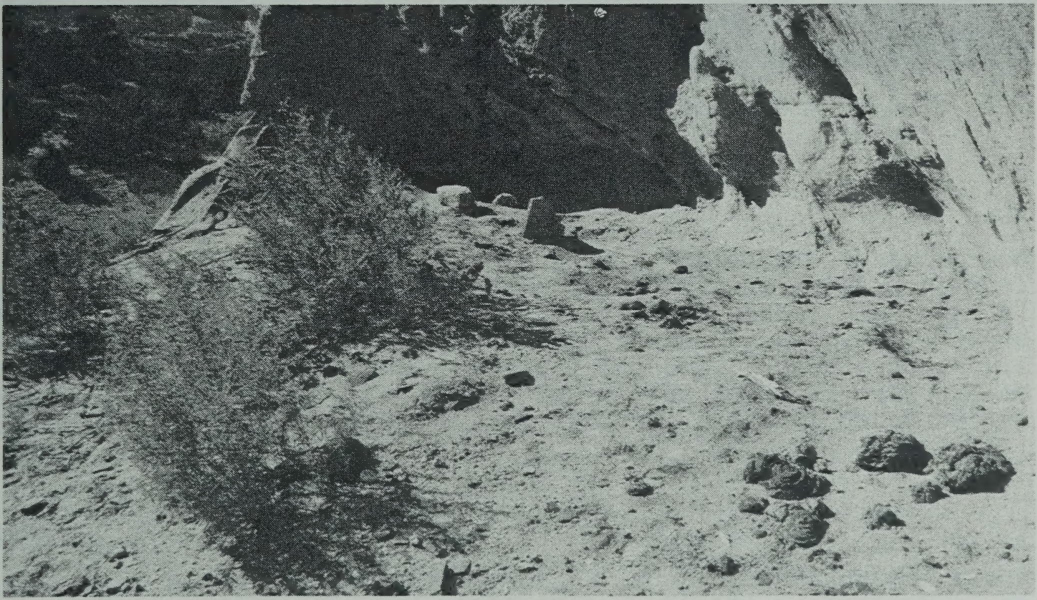


Figure 6. 42GA651, View of overhang.

Figure 7. 42GA651, Showing location of Plot G with person at left.

the shelter. The interior digging unearthed a pile of crudely shaped sandstone slabs that may once have been part of a structure. Flakes and ground stone fragments litter mounds of fill that resulted from the illegal excavation. No undisturbed fill remains in the shelter.

Buckles described only a limited scatter of debris in front of the shelter with dimensions of 22.87 m by 45.73 m. At 20 m south of the shelter and extending 27 m east-west, the density of flakes exceeds 100/m2. This density increases to over 200/m2 near the shelter. Cultural material extends 162 m from east to west by 41 m from north to south. Chalcedony serves as the raw material for the vast majority of the lithic debris. A few flakes of obsidian were observed. Buckles noted only a "few fragments of small, broken manos." In 1985, numerous fragments of manos and metates were observed and less than one dozen pottery sherds. Historic graffiti has also increased since 1958. In 1985, another small alcove was discovered 25 m west of the west edge of the shelter. The alcove extends only five meters from northeast to southwest and is 30 cm high. A packrat midden has filled the interior of the alcove. Flakes and recent deer bone lie on the floor of the shelter. Flake density reaches 50/m2 in front of the dripline for the shelter.

In 1973, the road from the Post south along Halls Creek was closed. One hundred people used this road before its closure. In the year after it was closed, 25 hikers used the route (USDI 1974:31). The closure of the jeep road saved 42GA456 from further damage. The higher number of users of the Halls Creek road and their ability to bring equipment such as shovels in their vehicles before 1973 hastened the depredation of 42GA456. Impact to the site should have lessened since 1973. However, the close proximity of the site to the Halls Creek hiking route makes it easily accessible to campers for illegal ground fires and other forms of disturbance.

42GA457

The 1985 investigation of this site revealed the condition of the three shelters to be approximately as it was in 1958 (Figs. 9-10). Five structures were identified within Shelter C. Unshaped sandstone blocks compose each of the structures. Some of these blocks have ground surfaces on them. Cattle dung was observed in Shelter C. Lithic debris was noted at all three shelters. Shelter C exhibits some historic graffiti dated before 1958.

42GA458

Buckles discussed a small structure of upright sandstone slabs in his site description in 1958 (Figs. 11-12). A number of sandstone slabs litter the shelter floor. None of these are upright. The walls of the structure are outlined. Buckles

Figure 8. 42GA456, Site overview.

Figure 9. 42GA457, Shelter A.

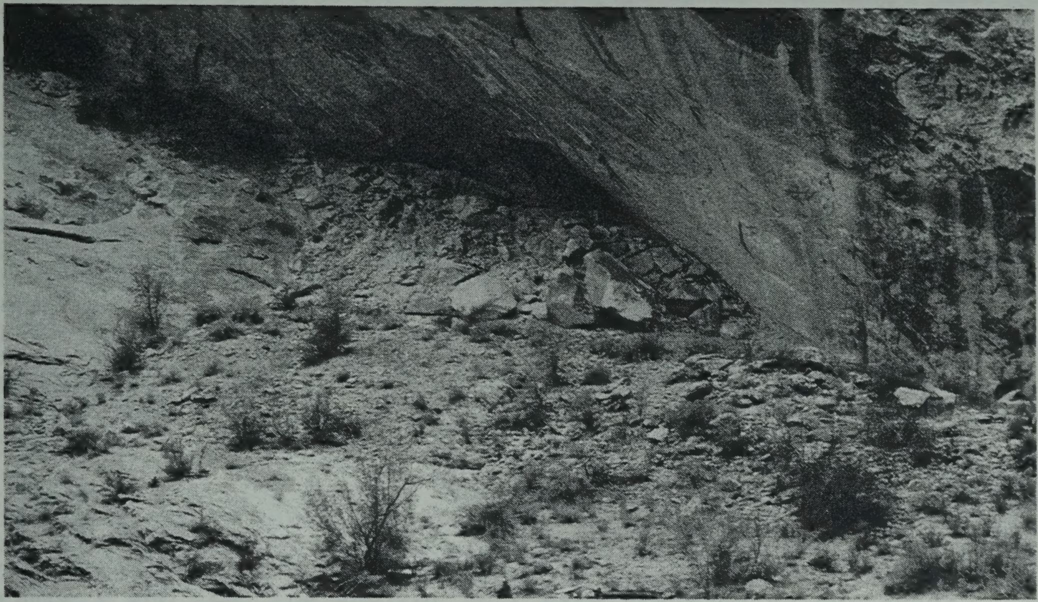


Figure 10. 42GA457, Shelter B.

Figure 11. 42GA458, Site overview. Note: 42GA459 is at left.

Figure 12. 42GA458, View into shelter.

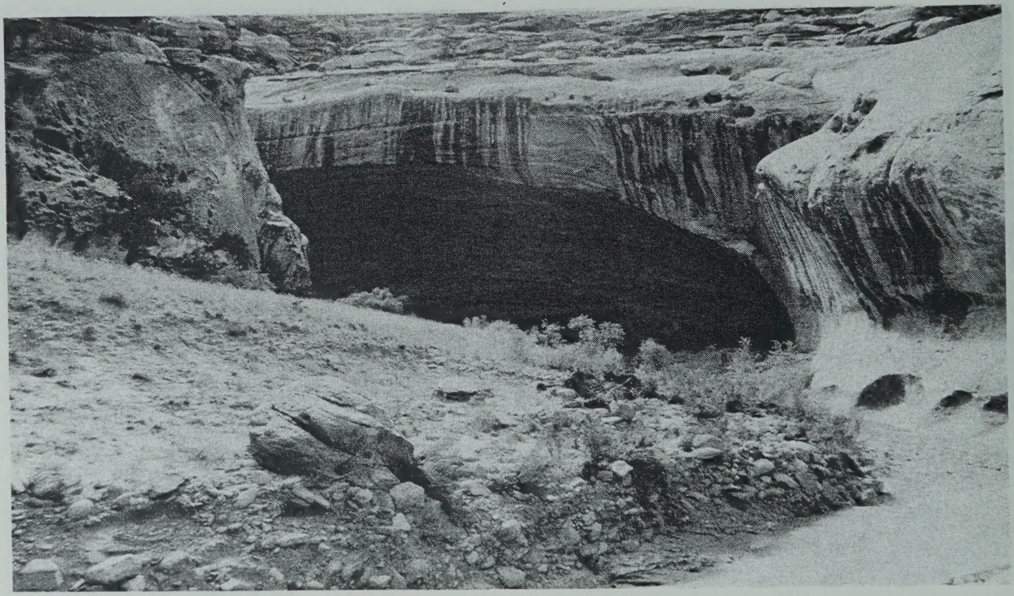


Figure 13. 42GA459, Site overview from drainage.

postulated that cattle had knocked over the slabs. Cattle have continued to disturb the shelter floor between 1958 and 1985 to the point where even the outline of the structure is difficult to discern. Campers have also made use of the shelter.

42GA459

This shelter is cavernous in size (Fig. 13). Modern campers made many improvements to the shelter floor. Wooden benches have been placed near the back wall of the shelter. These benches are set up 65 m from the south end of the shelter. A rectangular alignment of unshaped sandstone slabs that may have been a prehistoric structure lies 93 m from the south end of the shelter. Lister noted this alignment on his site form. Chalcedony flakes and three chalcedony bifaces were found in and around this structure. In fact, the density of flakes around the structure reaches 10/m2.

Lister mentioned that the shelter contained much modern refuse. The refuse documented in 1985 includes tin cans, automobile leaf springs, glass, a pulley, and historic hearths. The historic activity at the site has been intensive. Many campers who used the shelter must have traveled by horseback. A tether post for horses stands just inside the shelter. Horse and cow dung litter the floor of the shelter. A number of names have been carved in the rear wall of the shelter. Many of these names are dated to the 1920s. Among these names is that of "Carlile Baker 9/10/24." Baker was the son of Eugene Baker of Baker Ranch.

42GA460

Nichols, in his site form, defined the site as consisting of "two poorly preserved storage structures (cists?)." Cist 1 was still visible in 1985. However, cist 2 was barely distinguishable. Nichols mentioned that wind-blown sand covered the cists. Perhaps this sand accumulated sufficiently between 1958 and 1985 to bury cist 2. Other than the indistinct outline of cist 1, no other cultural material was noted in 1958 or in 1985. The site is inaccessible to cattle and does not appear to have been used by modern campers.

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APPENDIX IV

FIELD ARTIFACT RECORD FORM

CAPITOL REEF EXPERIMENTAL ARTIFACT PLOT RECORD

Cat. No.__________ Subplot No.____________ Quad. No.________

Artifact
Cat. No.
____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Artifact
Condition:

Visible (in situ)	____	____	____	____	____	____	____	____	____	____
Visible (displaced) -In Cell	____	____	____	____	____	____	____	____	____	____
-Out Cell	____	____	____	____	____	____	____	____	____	____
-Out Quad	____	____	____	____	____	____	____	____	____	____
Not Visible	____	____	____	____	____	____	____	____	____	____
Broken	____	____	____	____	____	____	____	____	____	____
#Frags.	____	____	____	____	____	____	____	____	____	____
Modified Min.=<33%	____	____	____	____	____	____	____	____	____	____
Mod.33-66%	____	____	____	____	____	____	____	____	____	____
Extr.>66%	____	____	____	____	____	____	____	____	____	____

Plot Condition:
Disturbed:
Livestock Activity: Walk-thru___ Trampling___ Grazing___
Other(specify)______________________________
Human Activity: Walk-thru___ Drive-thru___ Collecting____
Other(specify)______________________________
Wildlife Activity: Walk-thru___ Burrowing____ Collecting___
Other(specify)______________________________
Natural Physical Processes: Erosion- alluvial___; eolian___
Deposition-alluvial___;eolian___
Other(specify)______________________________
____

REPORT CERTIFICATION

I certify that "Impacts Of Domestic Livestock Grazing On The Archeological Resources Of Capitol Reef National Park, Utah" by Alan Osborn, et al.Occasional Studies in Anthropology No. 20

has been reviewed against the criteria contained in 43 CFR Part 7 (a)(1) and upon recommendation of the Regional Archeologist has been classified as available.

Regional Director

11/23/92
Date

Classification Key Words:

"Available"--Making the report available to the public meets the criteria of 43 CFR 7.18(a)(1).

"Available (deletions)"--Making the report available with selected information on site locations and/or site characteristics deleted meets the criteria of 43 CFR 7.18 (a)(1). A list of pages, maps, paragraphs, etc. that must be deleted for each report in this category is attached.

"Not Available"--Making the report available does not meet the criteria of 43 CFR (a)(1).